

DENTIFRICES AND MOUTHWASHES INGREDIENTS AND THEIR USE

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	Page no
CONTENTS	2
1. PREFACE	4
2. INTRODUCTION	4
3. HISTORY	4
4. COMPONENTS OF TOOTHPASTES AND MOUTHWASHES	5
4.1 ABRASIVES	6
4.2 THICKENING/BINDING AGENTS	6
4.3 HUMECTANTS	6
4.4 SOLVENTS	6
4.5 DETERGENTS (SURFACTANTS)	6
4.6 FLAVOURING AGENTS	7
4.7 SWEETENERS	7
4.8 COLOURING AGENTS	7
4.9 PRESERVATIVES	7
4.10 THERAPEUTIC AGENTS	7
4.10.1 ANTI-CARIES AGENTS	8
4.10.1.2 Fluoride	
4.10.1.2 Xylitol	
4.10.1.3 Calcium/Phosphate	
4.10.1.4 Sodium Bicarbonate	
4.10.2 ANTI-PLAQUE AGENTS	9
4.10.2.1 Sodium Lauryl Sulphate (SLS)	
4.10.2.2 Triclosan	
4.10.2.3 Metal-ions	
4.10.2.4 Amyloglucosidase and Glucose oxidase	
4.10.2.5 Essential oils	
4.10.2.6 Chlorhexidine	
4.10.3 ANTI-CALCULUS AGENTS	11
4.10.3.1 Pyrophosphate	
4.10.3.2 Zinc	
4.10.4 ANTI-DENTINE HYPERSENSITIVE AGENTS	12
4.10.4.1 Potassium salts	
4.10.5 ANTI-APHTHOUS AGENTS	12
4.10.5.1 Aminoglucosidase and Glucose oxidase	
4.10.6 WHITENING AGENTS	12
4.10.6.1 Abrasives	
4.10.6.2 Dimethicone	

4.10.6.3 Papain	
4.10.6.4 Sodium bicarbonate	
4.10.7 ANTI-HALITOSIS AGENTS	13
4.10.7.1 Zinc	
5. TOOTHPASTES FOUND ON THE NORWEGIAN MARKET AND THEIR INGREDIENTS	13
5.1 AIR-LIFT	13
5.2 AQUAFRESH	13
5.3 AYURDENT	14
5.4 BIOFORCE	14
5.5 BIOTENE	15
5.6 BUTLER GUM	15
5.7 CLINOMYN	15
5.8 COLGATE	16
5.9 FOREVER BRIGTH	17
5.10 HAAKON	17
5.11 KINGFISHER	18
5.12 LAYADONT	18
5.13 NATURAL WHITE	18
5.14 REMBRANDT	18
5.15 SALUTEM	19
5.16 SENSODYNE	19
5.17 SI-KO	20
5.18 SOLIDOX	20
5.19 TOLPA	21
5.20 WELEDA	21
5.21 YOTUEL	22
5.22 ZENDIUM	22
5.23 ZYMBION	23
6. MOUTHWASHES FOUND ON THE NORWEGIAN MARKET AND THEIR INGREDIENTS	23
6.1 COLGATE	23
6.2 CORSODYL	23
6.3 DENIVIT	23
6.4 FLUORID	24
6.5 HEXTRIL	24
6.6 LISTERINE	24
6.7 SIKITOL	24
6.8 SOLIDOX	25
6.9 VADEMECUM	25
6.8 ZENDIUM	25
7. INGREDIENTS OF TOOTHPASTES AND MOUTHWASHES IN ALFABETICAL ORDER	26
8. REFERENCES	45

1. PREFACE

This paper is submitted as partial fulfillment of the requirement for the degree Candidatus/Candidata Odontologiae (DDS) by the Faculty of Dentistry, University of Oslo, Norway. We would like to thank Professor Lasse A. Skoglund, DDS, DSci, for his expertise and guidance in the creation of this paper, and Karl Iver Hanvold, DDS for his support and dedication.

2. INTRODUCTION

Most people brush their teeth twice daily with a toothpaste and many of us even supply this with a mouthwash. Toothpastes and mouthrinses are sold world wide in foodstores, drugstores, chemists, healthstores and some are even sold in dental clinics.

The variety of different dentifrices is enormous. Brand names like Colgate, Sensodyne and Solidox are familiar to most of us, but what about brand names such as Bioforce and Ayurdent...? What is it that makes the consumer choose what product he or she wants? Do they wonder about the ingredients added in dentifrices? Do they ask their dental hygienist or dentist for recommendations in order to choose the “right” product? Or is it the grand marketing campaigns from the producers that has the biggest influence?

There is no doubt that the general knowledge regarding toothpastes and mouthwashes often come from commercials. We have all seen the commercials that show us handsome people with flashy white smiles. The commercials want us to believe that a certain toothpaste can give the consumers whiter and cleaner teeth, a fresh breath, fight plaque and calculus formation, and prevent gingivitis. But what the commercials fail to tell us is that what is first and foremost important is not the product that is being used but using a correct brushing action. Consequently many people have unrealistic and high expectations to the effect of the products. But there is no doubt that brushing with a toothpaste has positive effects, especially if it contains therapeutic agents such as fluoride. It is important to be aware of the fact that the main aim of toothpastes and mouthrinses is to make the tooth brushing comfortable. The best advice to the consumers is to underline the importance of brushing with a toothpaste at least once a day using a soft bristled toothbrush and a correct brushing action.

As soon-to-be dentists we feel that it is important to have a certain knowledge about oral hygiene products. Today patients are becoming more and more alert and they are often curious to find out more about the products they use daily. The purpose of this paper was to present the most common toothpastes and mouthwashes in Norway with their ingredients, and also collect information about the different ingredients and their actions. This knowledge may help dental practitioners in guiding their patients.

In the following you will find an overview of the main components of toothpastes and mouthrinses. For the so-called active ingredients we have explained their supposed effect as therapeutic agents. We have also made a summary of the most common toothpastes and mouthrinses on the Norwegian market at the time of writing. We have covered all the products sold in grocery shops and the main pharmacies, in addition we have included some natural products from health food stores. In the end of this paper you will find a complete glossary of all ingredients in the submitted products.

3. HISTORY

People of all times have been interested in their dental health, and toothpastes have ancient roots. There is found a prescription of a toothpaste that can be dated back to the time b.c. in Ebers Papyrus, an Egyptian medical reference book. But Hippocrates (460-377 b.c.) is

generally considered to be the first to recommend the use of a dentifrice. This was made of the ashes from hares and mice. It was believed that animals which obviously had strong teeth contained some substances that would pass this attribute on to the humans. The Romans also took great care of their teeth. They washed and rubbed them with wool and made dentifrice by grinding horn and animal skulls mixed with goats fat. The use of salt and myrrh in oral hygiene is also described by the Romans. It is also known that the Chinese used a mixture of salt, musk and urine to keep their teeth clean, sound and white, and to keep the gingiva healthy. In the Middle Ages they discovered that some of the substances used in toothpastes had anti-calculus effect. Patients were now advised to avoid harsh powders as they were liable to damage the substance of the teeth. Active ingredients during this time were astringents, germicidal agents and abrasives.

A new area in the science of preventive dentistry was ushered by W. D. Miller. In 1890 he described his chemoparastic theory of tooth decay. This new theory created a boom in the toothpaste industry with each manufacturer adding special agents. The industry underwent a great change to constituents with an alkaline base. The more modern aspect of dentifrices came after the Second World War. Many dental companies undertook scientific studies to establish a therapeutically rationale for using any dentifrice. But the real revolution considering therapeutically dentifrices came when different fluorides were added to toothpastes. This dramatically decreased the incidence of caries. Today four multinational companies dominate the dentifrice market. These are Colgate Palmolive (USA), Unilever (UK/Holland), Proctor & Gamble (USA) and Smith Kline Beecham (UK). In Norway the first mentioned is the dominating one.

As a supplement to toothpastes, different mouthwashes have been introduced on the market. Through the years a lot of different substances have been used as mouthwashes. For example in the Middle Ages people rinsed their mouth with vinegar and rose water. Today the production of mouthwashes is a big industry almost at the same level as the manufacturing of toothpastes (1,2).

4. COMPONENTS OF TOOTHPASTES AND MOUTHWASHES

Toothpastes

A toothpaste is defined as a semi-aqueous material for removing naturally occurring deposits from teeth and is supposed to be used simultaneous with a toothbrush. The main components of toothpastes are given in Table 1.

<i>Table 1 Main components of toothpastes</i>	
Abrasive	20 - 50 %
Water	20 - 40 %
Humectants	20 - 35 %
Detergent	1 - 3 %
Thickening agent	1 - 2 %
Flavour	0 - 2 %
Sweetener	0 - 2 %
Therapeutic agent	0 - 2 %
Colour or preservative	0,05 - 0,5 %

Mouthwashes

A mouthwash is defined as a non-sterile aqueous solution used mostly for its deodorant, refreshing or antiseptic effect. Mouthwashes or rinses are designed to reduce oral bacteria, remove food particles, temporary reduce bad breathe and provide a pleasant taste (3).

Mouth rinses are generally classified as either cosmetic or therapeutic or a combination of the two. Cosmetic rinses are commercial over-the-counter products that help remove oral debris before or after brushing, temporary suppress bad breath, diminish bacteria in the mouth and refresh the mouth with a pleasant taste. Therapeutic rinses often have the benefits of their cosmetic counterparts, but also contain an added active ingredient, f. ex. fluoride or chlorhexidine, that help protect against some oral diseases (4).

The amount of the different components in mouthwashes varies from product to product. Some practically have the same composition as toothpastes, although they do not contain abrasives. Distinct from toothpastes most mouth rinses contain alcohol, as a preservative and a semi-active ingredient (5). The amount of alcohol is usually ranging from 18 – 26 % (6).

4.1 ABRASIVES

An abrasive is a substance that is used for abrading, grinding or polishing (7). The degree of abrasivity depends on the hardness of the abrasive, the morphology of the particles, and on the concentration of abrasive in the paste. The abrasives found in toothpastes are often not as hard as the enamel, but as hard or harder than the dentine. Abrasives are most often found as crystals, small and smooth particles are preferred to avoid tooth wear. Transparent toothpastes, commonly called gel toothpastes, are obtained by mixing certain abrasives. The amount and type of abrasive in toothpaste contributes to give the toothpaste its creamy consistency. The abrasive effect is measured in the RDA (Radioactive Dentine Abrasion) scale, ranging from 40-80 in most toothpaste. Hydrated silica is a common abrasive in dentifrices; alumina and calcium carbonate may also be used.

4.2 THICKENING/BINDING AGENTS

A binder or thickener can prevent the toothpaste from drying out by binding water. They control the viscosity and contribute to give the toothpaste a creamy consistency. They also have an emulsifying effect by preventing the solid and the liquid substances from separating and give the possibility to make oil in water emulsions. Glycerol, Sorbitol, Polyethylene glycol (PEG), Propylene glycol and Cellulose Gum are common water-binding substances. Some thickening agents are obtained from algae for example Carageenan and Carbomer. Xanthan Gum is a natural product with similar properties.

4.3 HUMECTANTS

These are short-chained polyalcohols used in toothpastes to prevent loss of water, and subsequent hardening of the paste, when it is exposed to air. They also provide creamy texture. Glycerine and sorbitol are frequently used.

4.4 SOLVENTS

Water is the most common solvent used in toothpaste. It dissolves the ingredients and allows them to be mixed. Alcohol is used in mouth rinses as a solvent and taste enhancer.

4.5 DETERGENTS (SURFACTANTS)

Detergents are cleansing or purging agents that through a surface action that depends on their possessing both hydrophilic and hydrophobic properties, exerts cleansing (oil-dissolving) and antibacterial effects (7).

Detergents lower the surface tension of the liquid environment in the oral cavity so that the substances in the toothpaste/mouthwash can contact the teeth more easily. They penetrate and dissolve plaque. This makes it easier to clean the teeth. The foaming effect produced by the detergent is also beneficial in cleaning the teeth, and contributes to remove debris and gives a feeling of cleanness. Another function of the detergent is to help in dispersing the flavours in the toothpaste/mouthwash.

The most widely used detergent is Sodium Lauryl Sulphate (SLS). Unfortunately, SLS may have some adverse effects including damaging the mucin layer by denaturizing its glycoprotein (8). It has also been claimed that there is a connection between the use of toothpaste or mouthwash containing SLS and an increased frequency of recurrent aphthous ulcers (RAU) in some patients. A product without SLS may thus be recommended for patients with RAU (8). The adverse effects of SLS have resulted in the development of toothpaste and mouthwashes with alternative detergents such as Sodium Lauryl Sarcosinate, Cocamidopropylbetaine and Steareth-30. Common for these detergents are that they are less irritating to the oral mucosa.

4.6 FLAVOURING AGENTS

Combinations of water-insoluble essential oils, such as spearmint, peppermint, eucalyptus and menthol are often used as flavouring agents in toothpastes and mouthwashes. The flavouring agents are solubilized and dispersed through the paste or liquid via the detergent. Toothpastes and mouthwashes often have a very strong flavour. This is necessary to cover the horrid taste of most detergents, especially SLS. Flavouring agents are also added to meet the customers demand for a fresh sensation during and after brushing the teeth or rinsing the mouth. Usually the flavouring agents represent the main cost of the raw materials, approximately 60 %.

4.7 SWEETENERS

Sweeteners also improve the taste of toothpastes and mouthwashes and give them a mild and sweet taste. Several toothpaste companies make their own toothpaste for children with an even sweeter taste. The most common used sweeteners are sodium saccharin, sorbitol and glycerin. Xylitol is a sweetener that is also claimed to provide anti-caries activity.

4.8 COLOURING AGENTS

Most toothpastes and mouthwashes contain colour-substances to give them an attractive appearance. The colour-substances are classified by the Colour Index (CI), published by the Society of Dyers and Colourists and the American Association of Textile Chemists and Colourists, or by a system called the F D & C Colours. Titanium dioxide is often added to toothpastes to give them a white, opaque colour.

4.9 PRESERVATIVES

Preservatives prevent the growth of micro-organisms in toothpastes and mouthwashes. Common preservatives include sodium benzoate, methylparaben and ethylparaben.

4.10 THERAPEUTIC AGENTS

One or more therapeutic agents are usually added to toothpastes and mouthwashes. Most toothpaste today contain fluorides to prevent caries. Recently there has been a development of

different toothpastes with additional purposes, such as stain and calculus removal, and prevention of gingivitis, sensitive teeth and gum problems. In the following text we have categorised the different therapeutic agents according to their claimed effect.

4.10.1 ANTI-CARIES AGENTS

4.10.1.1 Fluoride: Fluoride is considered to be the most effective caries-inhibiting agent, and almost all toothpastes today contain fluoride in one form or the other. The most common form is sodium fluoride (NaF), but mono-fluoro-phosphate (MFP) and stannous fluoride (SnF) are also used. The fluoride amount in toothpaste is usually between 0.10-0.15 %. Fluoride is most beneficial when the mouth is not rinsed with water after tooth brushing. In this way a bigger amount of fluoride is retained in the oral cavity (9). Toothpastes are the main vehicle for fluoride. The combined therapeutic and cosmetic mouthwashes usually also contain fluoride, but in a non-therapeutic dose. However, there are fluoride-rinses with higher fluoride concentrations.

There are three main theories considering the positive action of fluoride in the prevention of caries:

1. It is claimed that fluoride, incorporated into the enamel during tooth development in the form of fluorhydroxyapatite (FAP), reduces the solubility of the apatite. This theory implies that “caries resistance”, once obtained, will last always. And that fluoride provided during the mineralization of the teeth is significantly more effective than when given later on. This theory has some drawbacks since individuals who are born and raised in an area with fluoridated water, and therefore have their teeth mineralised under optimum fluoride conditions; quickly achieve a caries incidence characteristic of their new location if they leave the fluoride area (10). Too much fluoride during tooth development can cause dental fluorosis (11).

2. It is also suggested that fluoride has anti-bacterial actions. In an acidic environment, if fluoride is present, hydrogen fluoride (HF) is formed. HF is an undissociated, weak acid that can penetrate the bacterial cell membrane. The entry of HF into the alkaline cytoplasmic compartments results in dissociation of HF to H^+ and F^- . This has two separate, major effects on the physiology of the cell. The first is that the released F^- interacts with cellular constituents, including various F-sensitive enzymes. The second effect is an acidification of the cytoplasmic compartment caused by the released protons. Normally protons are pumped out of the cell, but fluoride inhibits these processes. The decreased intracellular pH will make the environment less favourable for many of the essential enzymes required for cell growth (11).

3. Today the most important anti-caries effect is claimed to be due to the formation of calcium fluoride (CaF_2) in plaque and on the enamel surface during and after rinsing or brushing with fluoride. CaF_2 serves as a fluoride reservoir. When the pH drops, fluoride and calcium are released into the plaque fluid. Fluoride diffuses with the acid from plaque into the enamel pores and forms fluoroapatite (FAP). FAP incorporated in the enamel surface is more resistant to a subsequent acid attack since the critical pH of FAP (pH=4.5) is lower than that of hydroxyapatite (HA) (pH=5.5). Fluoride decreases the demineralization and increases the remineralization of the enamel between pH 4.5-5.5, and hence the demineralization period is shortened (11).

4.10.1.2 Xylitol: Xylitol is a sugar alcohol that cannot be fermented by oral micro-organisms. It is considered to be a cariostatic agent since it can inhibit the carbohydrate metabolism in different oral micro-organisms. Xylitol seems to be unique among the sugar alcohols in its inhibitory effect on glycolysis. The inhibitory effect on glycolysis has been related to the uptake of xylitol via a constitutive fructose specific PTS system and subsequent intracellular accumulation of xylitol-5-phosphate. Such a mechanism leads to reduced acid formation from glucose, and a reduction in the streptococcus mutans content in both plaque and saliva (12). But different studies show a great variance in the anti-caries effect of xylitol.

4.10.1.3 Calcium/Phosphate: Calcium and phosphate supplementation in a toothpaste or mouth rinse will increase the concentration of these ions in the oral cavity. This has been reported to improve remineralization and increase fluoride uptake (13).

4.10.1.4 Sodium Bicarbonate: Several studies have shown that bicarbonate is one of the salivary components that potentially modifies the formation of caries. It increases the pH in saliva, and in this way creates a hostile environment for the growth of aciduric bacteria. Sodium bicarbonate can also change the virulence of the bacteria that cause tooth decay. Animal studies have shown that dentifrices containing sodium bicarbonate reduce the amount of both *S. sobrinus* and *S. mutans*, and this may reduce caries. Studies on human show a statistically reduction in number of mutans streptococci. Sodium bicarbonate can also prevent caries by reducing enamel solubility and increase remineralization of enamel (14).

4.10.2 ANTI-PLAQUE AGENTS

4.10.2.1 Sodium Lauryl Sulphate (SLS): It has been shown that the enzymes glucosyltransferase and fructosyltransferase are incorporated in an active form into the pellicle; and by synthesizing glucan *in situ* from sucrose, can provide a surface for colonization by *Streptococcus mutans*. These enzymes can be inhibited by SLS. Such inhibition can clearly retard the regrowth of plaque (1).

4.10.2.2 Triclosan: Triclosan is a synthetic non-ionic chlorinated phenolic agent with antiseptic qualities. Triclosan has a broad-spectrum efficacy on Gram-positive and most Gram-negative bacteria. It is also effective against mycobacterium and strictly anaerobic bacteria, and against the spores and fungi of the Candida species. The mechanism of its antiseptic action is by acting on the microbial cytoplasmic membrane, inducing leakage of cellular constituents and thereby causing lysis of the micro-organisms. In spite of its activity *in vitro*, clinical plaque studies have revealed only moderate levels of antiplaque activity (15). Evidence has accumulated to suggest that triclosan in itself does not produce optimal plaque inhibitory effects without the addition of other chemicals which increase its antibacterial effect. Most commonly used are copolymer PVM/MA and zinc citrate. They enhance surface retention of triclosan (16). An antiseptic has to be retained in the oral cavity for a certain amount of time in order to have antiplaque activity. The retention sites for triclosan are not yet established, but the teeth and the micelles in saliva are suggested (15). Triclosan also has anti-inflammatory effect by acting on the eicosanoid-cascade. Triclosan inhibits both cyclooxygenase (COX) and lipoxygenase (LOX), and thereby inhibits the production of prostaglandins and leukotrienes (15). Clinical studies also indicate that triclosan reduces oral mucosal irritation caused by sodium lauryl sulphate (SLS) (17, 18).

4.10.2.3 Metal-ions: The most widely used metal-ions in dental preparations are zinc (Zn^{2+}) and stannous (Sn^{2+}). These metals have the ability to limit bacterial growth, inhibit plaque

formation, inhibit the glycolytic sequence in oral anaerobic bacteria, and to restrict the ability of plaque bacteria to convert urea to ammonia (1). They can also inhibit some bacterial enzymes. It is also possible that they can reduce the bacteria's ability to colonize the tooth surfaces (9).

- **Stannous- ions:** Stannous-ions are added to dentifrices and mouthwashes in the form of stannous fluoride or stannous pyrophosphate. Stannous fluoride was frequently used as a vehicle for fluoride in dental preparations in the 1960s and 1970s. At present time it is rarely used, although extensive research during the last two decades has established that stannous fluoride possesses several interesting properties. It has been claimed that stannous fluoride is more effective in caries inhibition than sodium fluoride and monofluorophosphate. This is probably because stannous fluoride has additional properties compared with other fluoride vehicles. However such differences are not always statically significant in small-scale studies (19). Mouth rinses containing stannous fluoride have been found to reduce the relative amounts of *S. mutans* and *S. sanguis* in plaque, to reduce the population of *S. mutans* in saliva and to increase the salivary levels of *lactobacilli* (1). The stannous fluoride treated enamel becomes hydrophobic, a property which may contribute to the antiplaque effect of stannous fluoride, since hydrophobic surfaces are less easily colonised by bacteria (19). The cariostatic protection provided by stannous fluoride is dependent on a deposition of CaF reservoir on the tooth surface (Fluoride theory nr 3). Both the antiplaque effect and the inhibition of acid formation by stannous fluoride are most likely caused by the oxidation of thiol groups which stannous fluoride is known to perform. Stannous ions may inhibit bacterial glycolysis because the enzymes depend on the thiol group for their biological activity (19). The antiplaque effect of SnF can clearly also contribute to the cariostatic activity.

- **Zinc ions:** Zinc is added to toothpastes and mouthwashes as zinc chloride or zinc citrate. Zinc is a relatively non-toxic, non-cumulative essential trace element Zinc inhibits the PTS pathway of glucose uptake by *S. Mutans*, *S. sanguis* and *Actinomyces naeslundii*, and the metabolism of glucose to lactic acid. The effects of zinc are believed to be intracellular, resulting from the inhibition of sulphydryl enzymes, specifically enzyme I in the phosphotransferase transport system and aldolase and glyceraldehyde dehydrogenase in the glycolytic pathway. Zinc also inhibits the trypsin-like protease activity of *P. gingivalis* and of *C. gingivalis* (1). The role of zinc in plaque inhibition or as a calculus inhibitory agent when used in dentifrices has been established by a number of workers (1). It is shown that detergents enhance the plaque-inhibitory role of zinc (20).

4.10.2.4 Amyloglucosidase and Glucose oxidase: These are enzymes that are claimed to reduce plaque, gingivitis and dental caries. Their mechanism of action is by activating the antibacterial lactoperoxidase-thiocyanate system in saliva (2). Amyloglucosidase and glucoseoxidase can degrade starch and glucose to H₂O₂. The released peroxides will react with thiocyanate-ion present in saliva, converting it to hypothiocyanate, which can inhibit bacterial growth. Although in vitro data supports this pathway, no evidence exists that shows that this occurs in the oral environment (1). Only a slightly improved anti-gingivitis effect has been found when compared with a non-enzymatic dentifrice (1).

4.10.2.5 Essential oils: Essentials oils of thymol, menthol, eucalyptol and methyl salicylate are thought to have anti-bacterial activity by altering the bacterial cell wall. Mouth rinses containing these active ingredients have been reported to reduce plaque and gingivitis significantly.

4.10.2.6 Chlorhexidine: Chlorhexidine formulations are considered to be the “gold standard” antiplaque mouthrinses due to their prolonged broad spectrum antimicrobial activity and plaque inhibitory potential (21). Chlorhexidine is effective against both Gram-positive and Gram-negative bacteria, but has most effect against Gram-positive bacteria. Chlorhexidine is bacteriostatic at very low concentrations, especially against *S. mutans*. It also has effect against fungi, but non or little effect against spores. It also has effect against some viruses. Chlorhexidine is retained in the oral cavity for 24 hours by binding to phosphate, sulphate and carboxyl groups in bacteria, plaque, saliva and on the enamel surface. The anti-bacterial action is due to a disturbance of the transport through the cell membrane and of the bacterial metabolism, and by causing leakage through the cell membrane. Its antiviral effect is caused by interaction with the viral protein cap. It is also reported that chlorhexidine affects the chemotaxis, release of free oxygen radicals and degranulation by the polymorph nuclear neutrophil leucocytes, and thereby has an influence on the inflammatory process. Whether this has any clinical relevance in the oral cavity has not yet been established (22).

Sodium lauryl sulphate appears to adversely affect the retention of chlorhexidine and its plaque-inhibiting action. Rinsing with chlorhexidine should therefore not be performed in combination with tooth brushing. Sodium monofluoride, stannous fluoride and Nystatin also dramatically reduces the effect of chlorhexidine (22). Chlorhexidine is usually employed as a chemical supplement or adjunct to tooth brushing for plaque control f.ex. following oral surgery or by patients that cannot attain optimal oral hygiene. Local side effects of chlorhexidine including disturbance of taste and staining of teeth, tongue and restorative materials have tended to restrict its use to only a short term (21).

4.10.3 ANTI-CALCULUS AGENTS

Of the anti-calculus agents, the crystal growth inhibitors have been most extensively tested clinically. These agents act by delaying dental plaque calcification, thereby promoting plaque removal with normal tooth brushing (23).

4.10.3.1 Pyrophosphate: Pyrophosphate has recently been introduced in dentifrices to inhibit the formation of supragingival dental calculus. Pyrophosphate is added as tetrasodium pyrophosphate, tetrapotassium pyrophosphate or disodium pyrophosphate. It has been shown that pyrophosphate has high affinity to hydroxyapatite (HA) surfaces, probably by an interaction with Ca^{2+} in the hydration layer. By interacting with HA and the enamel surface, pyrophosphate reduces their protein-binding capacity. It also has the ability to inhibit calcium phosphate formation. It is therefore conceivable that pyrophosphate introduced in the oral cavity through dentifrices may affect pellicle formation. However, the P-O-P bond of pyrophosphate is known to be susceptible to enzymatic hydrolysis by plaque and salivary phosphatases, and the effect may thus be of limited duration in the oral cavity (1).

Consequently, the tartar control dentifrices that contain pyrophosphate as a calculus inhibitor also incorporate phosphates inhibitors that prolong the activity of pyrophosphate in the mouth. Studies have indicated that fluoride in combination with PVM/MA Copolymer gives a significant protection of pyrophosphate against phosphatases (24). The clinical consequences of a poorly formed or partly missing pellicle are not known. Suggested consequences are abrasion of teeth, increased demineralisation, and hypersensitivity of teeth (1).

4.10.3.2 Zinc: Zinc has anti-calculus effect due to its anti-plaque properties, but in addition it is thought to influence calculus formation by inhibiting crystal growth.

4.10.4 ANTI-DENTINE HYPERSENSITIVITY AGENTS

Although the condition is referred to as “dentine hypersensitivity” it isn’t really the dentine that is sensitive. The sensitivity of dentine is caused by fluid-filled tubules in communication with the pulp (1).

4.10.4.1 Potassium salts: Potassium ions are thought to act by blocking action potential generation in intradental nerves (25). It is claimed that potassium salts in dental preparations increase the concentration of potassium ions around the pulpal nerves, and thereby depolarises the nerve. This can inhibit a nerve response from different stimuli (2). The exact mechanism by how potassium desensitises dentine is yet to be elucidated, but the toothpaste manufacturers, typically claim that the desensitising effect is due to the potassium ion. This statement is based on results from animal studies indicating that by increasing the extra cellular potassium ion concentration in very deep dentine cavities, it is possible to depolarise nerve fibre membranes, and render them unable to repolarize because of the maintained high levels of extra cellular potassium ions. But there is no strong evidence available to support the efficacy of potassium in toothpaste for dentine hypersensitivity in humans (26).

4.10.5 ANTI-APHTHOUS AGENTS

4.10.5.1 Aminoglucosidase and Glucose oxidase: Enzymatic toothpastes and mouthwashes do not contain detergents like SLS because the detergent can denaturate the enzymes. SLS may induce adverse effects in oral soft tissues and increases the frequency of ulcers in patients suffering from recurrent aphthous ulcers (RAU). Enzyme toothpastes can therefore be an alternative for patients suffering from RAU (2). There has also been reported that the use of a dentifrice or a mouthrinse containing the combination of the enzymes aminoglucosidase and glucose oxidase has a positive, inhibiting effect on RAU, in addition to that they do not contain SLS. The ulcers were generally reported to be smaller and less painful, to have a shorter healing time and the frequencies of aphthous ulcers episodes were decreased (27).

4.10.6 WHITENING AGENTS

Whitening toothpastes sold in Norway do not lighten the colour of the tooth structure; they simply remove surface stains with abrasives or special chemical or polishing agents, or prevent stain formation.

4.10.6.1 Abrasives: An abrasive is required for the effective removal of a discoloured pellicle. Abrasives provide a significant whitening benefit, particularly on smooth surfaces, but are of limited use for areas along the gum line and interproximally (28). Some whitening toothpastes contain coarse abrasives that can damage the dental tissue.

4.10.6.2 Dimethicones: Dimethicones are versatile substances that ranges from low molecular weight polydimethylsioxane fluids to high molecular weight polymers that are gum-like in nature (29). They cause a smooth surface on the tooth that prevents stain formation.

4.10.6.3 Papain: Papain is a sulfhydryl protease consisting of a single polypeptide chain, extracted from the *Carica papaya* plant. It is able to hydrolyse peptid bonds, and can also catalyse the transfer of an acyl group. It is used in toothpastes as a non-abrasive whitening agent (30).

4.10.6.4 Sodium bicarbonate: It is claimed that dentifrices containing high concentrations of sodium bicarbonate are more effective in removing intrinsic tooth stain than those not containing sodium bicarbonate (31).

4.10.7 ANTI-HALITOSIS AGENTS

4.10.7.1 Zinc: Bad breath or halitosis originates mainly from the oral cavity. The unpleasant smell is due to the retention of anaerobic, Gram-negative bacteria. These bacteria use sulphur-containing amino acids as substrates in their production of volatile sulphur-containing compounds (VSC). VSC have a distinctly unpleasant odour even in low concentrations. Zinc inhibits the production of VSC in the oral cavity by interacting with sulphur in the amino acids or their metabolism. Zinc can be retained in the oral cavity for approximately 2-3 hours after tooth brushing by binding to acidic substances on the oral mucosa, in the saliva or on bacterial surfaces (32).

5. TOOTHPASTES FOUND ON THE NORWEGIAN MARKET AND THEIR INGREDIENTS

5.1 AIR-LIFT

	Air-Lift Fresh Breath Toothpaste
Aqua	X
Sorbitol	X
Hydrated Silica	X
Xylitol	10.0 %
Glycerin	X
Olea Europaea	X
Aroma	X
Tetrapotassium Pyrophosphate	X
Acacia	X
Menthol	X
Tocopherol	X
Sodium Fluoride	1450 ppm F ⁻
Sodium Saccharin	X
Diazolidinyl Urea	X
Methyl Salicylate	X

5.2 AQUAFRESH

	Aquafresh Fresh Mint	Aquafresh Mild Mint	Aquafresh Natural Whitening	Aquafresh Gentle whitening + Complete care
Aqua	X	X	X	X
Hydrated Silica	X	X	X	X
Sorbitol	X	X	X	X
Glycerin	X	X	X	X
Pentasodium Triphosphate	X	X	X	X
PEG- 6	X	X	X	X
Sodium Lauryl Sulphate	X	X	X	X
Aroma	X	X	X	X
Titanium Dioxide	X	X	X	X
PVP				X

Xanthan Gum	X	X	X	X
Sodium Saccharin	X	X	X	X
Sodium Fluoride	X	1350 ppm F ⁻	1100 ppm F ⁻	1100 ppm F ⁻
Carrageenan	X	X		
Sodium Hydroxide			X	X
CI 73360	X	X	X	X
CI 74160	X	X		X
CI 74260		X		
CI 77891			X	
CI 42090			X	
CI 47005			X	

5.3 AYURDENT

	Herbal Toothpaste
Dicalcium Phosphate	X
Triticum Vulgare	X
Astragalus Gummiifer	X
Sodium Chloride	X
Octoxyglycerin	X
Dibenzylidene Sorbitol	X
Aqua	X
Albizzia Lebbeck	X
Barleria Prionitis	X
Mimusops Elengi	X
Terminalia Chebula	X
Terminalia Belerica	X
Emblica Officinalis	X
Quercus Infectoria	X
Glycyrrhiza Glabra	X
Acacia Catechu	X
Symplocos Racemosa	X
Juglans Regia	X
Piper Longum	X
Zingiber Officinale	X
Azadirachta Indica	X
Salvadora Persica	X
Mentha Piperita	X
Eugenia Carophyllus	X
Camphor	X

5.4 BIOFORCE

	Dentaforce toothpaste	Echinacea toothpaste
Aqua	X	X
Sorbitol	X	X
Glycerin	X	
Silica	X	X
Alcohol	X	X
Hydroxyethylcellulose	X	
Echinacea Purpurea	X	X
Mentha Piperita	X	X
Krameria Triandra	X	
Rosmarium Officinalis	X	X
Menthol	X	
Mentha Crispa	X	
Calcium Carbonate	X	
Chalk		X
Glycyrrhiza Glabra		X
Potentilla Erecta		X
Astragalus Gummiifer		X
Vaccinium Myrtillus		X
Acacia Catechu		X

Eucalyptus Globulus		X
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5.5 BIOTENE

	Biotene Toothpaste
Aqua	X
Sodium Monofluorophosphate	1400 ppm F ⁻
Xylitol	X
Sorbitol	X
Sodium Saccharin	X
Glycerin	X
Silica	X
Sodium Benzoate	X
Isoceteth-20	X
Cellulose Gum	X
Hydroxyethylcellulose	X
Titanium Dioxide	X
Glucose Oxidase	10.000 units pr 100 gm
Glucose	X
Lactoperoxidase	15.000 units pr 100 gm
Potassium Thiocyanate	X
Calcium	X
Aroma (Peppermint, Spearmint etc)	X

5.6 BUTLER GUM

	Butler Gum Critters	Butler Gum Sensitive
Aqua	X	X
Sorbitol	X	X
Hydrated Silica	X	X
Glycerin	X	X
Flavor	X	
Mint Flavor		X
Sodium Lauryl Sulphate	X	X
Xanthan Gum	X	X
Sodium Carboxymethyl Cellulose	X	X
Sodium Saccharin	X	X
Sodium Fluoride	850 ppm F ⁻	950 ppm F ⁻
Trisodium Phosphate	X	
MICA	X	
Sodium Hydroxide	X	X
Potassium Nitrate		5 %
CI 16255	X	
CI 47005	X	
CI 42090		X

5.7 CLINOMYN

	Clinomyn
Calcium Carbonate	X
Sorbitol	X
Aqua	X
Dicalcium Phosphate	X
Propylene Glycol	X
Aluminium Silicate	X
Sodium Lauryl Sulphate	X
Silica	X
Cellulose Gum	X
Sodium Monofluorophosphate	0.76 %
Flavour	X
Sodium Saccharin	X
Titanium Dioxide	X
Menthol	X

Dimethicone	X
Methylparaben	X
Propylparaben	X

5.8 COLGATE

	Colgate Herbal	Colgate Total	Colgate Fresh Confidence	Colgate Total Plus Whitening	Colgate Sensation Whitening	Colgate 2 in 1 Whitening	Colgate 2 in 1 Fresh Mint	Colgate 2 in 1 tannstenkontroll	Colgate Caries Control	Colgate Kids
Hydrated Silica		X	X	X	X	X	X	X		X
MICA										X
Calcium Carbonate	X									
Aqua	X	X	X	X	X	X	X	X	X	X
Sorbitol	X	X	X	X	X	X	X	X	X	X
Sodium Lauryl Sulphate	X	X	X	X	X	X	X	X	X	X
PEG – 12	X				X		X		X	X
Aroma	X	X		X	X	X	X	X	X	
Carrageenan	X	X	X	X	X	X	X	X		
Sodium Monofluorophosphate	X								1000 ppm F ⁻	
Sodium Fluoride		1450 ppm F ⁻	1450 ppm F ⁻	1450 ppm F ⁻	1450 ppm F ⁻	1500 ppm F ⁻	1500 ppm F ⁻	1500 ppm F ⁻	450 ppm F ⁻	1100 ppm F ⁻
Cellulose Gum	X	X	X	X	X	X		X	X	X
Sodium Silicate	X									
Sodium Saccharin	X	X		X	X	X	X	X	X	X
Glycerin		X	X	X	X	X	X	X	X	X
Triclosan		0.3%	0.3%	X						
PMV/MA Copolymer		0.25%	X	X	X	X		X		
Sodium Hydroxide		X	X	X	X	X		X		
Methylparaben	X									
Propylparaben	X									
Melaleuca Alternifolia	X									
Salvia Officinalis	X									
Eugenol	X									
Commiphora Myrrha	X									
Chamomilla Recutita	X									
Tetrapotassium Pyrophosphate					X					
Tetrasodium Pyrophosphate						X	X	X	X	X
Titanium Dioxide		X			X					
Cocamidopropyl Betaine						X	X	X		
Dicalcium Phosphate Dihydrate									X	
Pentasodium Triphosphate						X		X		
CI 74160			X							
CI 74260	X		X							
CI 77891				X						X
CI 42090				X		X	X	X		X

CI 19140								X		
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5.9 FOREVER BRIGHT

	Forever Bright Toothgel
Stabilized Aloe Vera Gel	X
Sorbitol	X
Hydrogenated Silica	X
Glycerin	X
Sodium Lauryl Sulphate	X
Carrageenan	X
Bi Propolis	X

5.10 HAAKON

	Denta Total	Billy Tannkrem For Barn
Aqua	X	X
Sodium Fluoride	1450 ppm F ⁻	1100 ppm F ⁻
Hydrated Silica	X	X
Xylitol	X	
Sorbitol	X	X
Propylene Glycol	X	
Glycerin	X	
Sodium C14-16 Olefin Sulphate	X	X
Xanthan Gum	X	
Aroma	X	X
Disodium Phosphate	X	
Titanium Dioxide	X	X
Triclosan	X	
Sodium Saccharin	X	X
Carbomer	X	
Sodium Methylparaben	X	
Sodium Phosphate	X	
Disodium Phosphate	X	X
Trisodium Phosphate		X
Citric Acid	X	
PEG-12		X
Cellulose Gum		X
Sodium Trimetaphosphate		X
Sodium Monofluorophosphate		X
Tocopherylacetate		X
Calciumglycerophosphate		X
Propylparaben		X
MICA		X
CI 42051		X

5.11 KINGFISHER

	Kingfisher Fennel with Fluoride	Kingfisher Natural White
Aqua	X	X
Calcium Carbonate	X	X
Glycerin	X	X
Sodium Lauryl Sulphate	X	X
Silica	X	X
Cellulose Gum	X	X
Sodium Monofluorophosphate	X	X
Foeniculum Vulgare	X	X
Anethole	X	
Mentha Piperita		X
Citrus Limonum		X

5.12 LAYADONT

	Layadont Toothpaste
Aqua	X
Sorbitol	X
Calcium Carbonate	X
Silica	X
Maris Sal (Sea Salt)	X
Sodium Methyl Cocoyl Taurate	X
Mentha Piperita	X
Aroma	X
Xanthan Gum	X
Sodium Saccharin	X
CI 75810 (Chlorophyll)	X

5.13 NATURAL WHITE

	Natural White Sensitive Teeth	Natural White Antiplaque & Tartar control
Aqua	X	X
Hydrated Silica	X	X
Glycerin	X	X
Potassium Nitrate	5 %	
Pentasodium Triphosphate	X	X
PVP	X	X
Sodium Lauryl Sulphate	X	X
Titanium Dioxide	X	X
Cellulose Gum	X	X
Aroma	X	X
Sodium Benzoate	X	X
Sodium Saccharin	X	X
Sodium Fluoride	1100 ppm F ⁻	1100 ppm F ⁻
Sorbitol		X
CI 16035	X	
Sodium Methyl Cocoyl Taurate		X

5.14 REMBRANDT

	Rembrandt Original	Rembrandt Mint	Rembrandt Intense Stain Removal	Rembrandt Sensitive	Rembrandt Cancer sore	Rembrandt Baking Soda	Rembrandt Natural toothpaste	Rembrandt Natural without Fluoride
Aqua	X	X	X					
Dicalcium Phosphate Dihydrate	X	X						
Glycerine	X	X	X					
Sorbitol	X	X	X					
Alumina	X	X	X					
Sodium Citrate	X	X	X					
Sodium Lauryl Sulphate	X	X	X					
Aroma	X	X	X					
Sodium Monofluorophosphate	X	X	1500 ppm F ⁻					
Sodium Carrageenan	X	X	X					
Papain	X	X	X					
Citric Acid	X	X	X					
Sodium Saccharin	X	X	X					

Methylparaben	X	X	X					
Cocamidopropyl Betaine		X	X					
Silica			X					
Dicalcium Phosphate			X					
Vitamin E			X					
FD & C Blue nr 1			X					
FD & C Yellow nr 5			X					
CI 42090	X	X						
CI 19140		X						

5.15 SALUTEM

	Salutem Toothpaste
Aqua	X
Crystalline Sorbitol	X
Hydrated Silica	X
Crystalline Xylitol	9.9 %
PEG	X
Anhydrous Natural Betaine	4.0 %
Cellulose Gum	X
Sodium Fluoride	1500 ppm F ⁻
Sorbate	X

5.16 SENSODYNE

	Sensodyne Fresh Mint	Sensodyne Gentle Whitening	Sensodyne Vital	Sensodyne Gel Spearmint
Aqua	X	X	X	X
Sorbitol	X		X	X
Hydrated Silica	X	X	X	X
Glycerin	X	X	X	X
Cocamidopropyl Betaine		X	X	
Potassium Chloride			X	
Cellulose Gum	X	X	X	X
Silica	X		X	
Zink Citrate			X	
Aroma	X	X	X	X
Sodium Saccharin	X	X	X	X
Sodium Fluoride	1450 ppm F ⁻	X	1450 ppm F ⁻	1450 ppm F ⁻
Tocopheryl Acetat			X	
Trisodium Phosphate	X		X	
Panthenol			X	
Citric Acid			X	
BHT			X	
Potassium Nitrate	X	X	X	5 %
Sodium Lauryl Sulphate	X			
Methylparaben	X			X
Propylparaben	X			X
Tetrapotassium Pyrophosphate		X		
Sodium Bicarbonate		X		
Silica		X		X
Ammonium Glycyrrhizate		X		
Sodium Methyl Cocoyl Taurate				X
CI 77891	X	X	X	
CI 42051				X
CI 47005				X

5.17 SI-KO

	SI-KO Fluor
Aqua	X
Glycerin	X
Potassium Tartrate	X
Silica	X
Sterculia Urens	X
PEG-150	X
Mentha Pitertita	X
Pimpinella Anisum	X
Eugenia Cariophyllus	X
Citrus Dulcis	X
Citrus limonum	X
Sodium Fluoride	X
Saccharin	X
Menthol	X
Tartaric Acid	X
Phenoxyethanol	X
Methylparaben	X
Diazoldinyl Urea	X
Ethylparaben	X
Propylparabel	X
Bethylparaben	X

5.18 SOLIDOX

	Solidox Fluor	Soliox Total	Solidox Total og ising	Solidox Hvite tenner	Solidox Frisk og mild	Solidox Frisk pust	Solidox Aktiv gel	Solidox Uten Fluor	Solidox Digimon
Aqua	X	X	X	X	X	X	X	X	X
Sorbitol	X	X	X	X	X	X	X	X	X
Hydrated Silica	X	X	X	X	X	X	X	X	X
PEG-32	X	X	X	X	X	X	X	X	X
Sodium Lauryl Sulphate	X	X	X	X	X	X	X	X	X
Aroma	X	X	X	X	X	X	X	X	X
Titanium Dioxide	X	X		X	X	X		X	
Sodium Fluoride	1500 ppm F ⁻	1500 ppm F ⁻	1500 ppm F ⁻	1500 ppm F ⁻	1000 ppm F ⁻	1000 ppm F ⁻	1500 ppm F ⁻		1000 ppm F ⁻
Potassium Sorbate	X				X	X			X
Sodium Saccharin	X	X	X	X	X	X	X	X	X
Cellulose Gum	X	X	X	X	X	X	X	X	X
Trisodium Phosphate	X				X	X	X	X	X
Zink Citrate		X	X	X		X	X		
Triclosan		X							
Potassium Citrate			X						
Stannous Pyrophosphate			X						
Tocopheryl Acetate									X
Calcium Gluconate									X
Sodium Benzoate								X	
Sodium Hydroxide								X	
Dimeticon				X					
Sodium Lauroyl Sarcosinate				X					
Ethyl Methane Carboxamide							X		

CI 75470		X							
CI 77891			X						
CI 42051									X
CI 42090							X		
CI 74160							X		

5.19 TOLPA

	Tolpa Dent Pasta	Tolpa Dent Gel
Aqua	16.03775 %	12.8395 %
Concentrated Peat Extract	0.01 %	0.01 %
Concentrated Chamomile Capitulum Extract	0.047 %	0.047 %
Sage Herb Concentrated Extract	0.3 %	0.3 %
Calcium Hydro Phosphate	41.0 %	
Xanthane Rubber	0.85 %	0.5 %
Glycerin 99.5%	10.0 %	12.0 %
Sorbitol 70%	23.5 %	45.5 %
Sodium Lauryl Sulphate	1.5 %	1.6 %
Sodium Saccharate	0.1 %	0.05 %
Peppermint Flavour 78370-34	0.5 %	1.0 %
Spearmint Flavour 77513-3	0.5 %	
Aseptine M	0.1 %	0.1 %
Aseptine P	0.005 %	0.05 %
Sident 22S	5.5 %	
Sident 9		14.0 %
PEG-400		3.5 %
CI 42051	0.003 %	0.002 %
CI 47005	0.00225 %	0.0015 %

5.20 WELEDA

	Sole- tandpasta	Ratanje- tandpasta	Calendula- tandpasta	Plante- tandgel	Børne- tandgel
Aqua	X	X	X	X	X
Sodium Bicarbonate	X				
Glycerin	X	X	X	X	X
Silica	X				
Fragrance	X				
Prunus Spinosa	X				
Cyanopsis Tetragonalba	X				
Commiphora Myrrha	X	X	X	X	
Krameria Triandra	X	X		X	
Aesculus Hippocastanum	X				
Esculin	X			X	X
Arum Maculatum	X				
Sodium Chloride	X				
Sodium Sulphate	X				
Sodium Silicate	X				
Alcohol	X	X	X	X	
Buxus Chinensis	X				
Calcium Carbonate		X	X		
Magnesium Aluminium Silicate		X	X		
Xanthan Gum		X	X		
Mentha Piperita		X		X	
Mentha Cardiac		X		X	X
Foeniculum Vulgare		X	X	X	X
Ammonium Glycyrrhizate		X	X		
Calendula Officinalis			X		X
Hydrated Silica				X	X

Algin				X	X
Chamomilla Recutita				X	

5.21 YOTUEL

	Yotuel Classic	Yotuel for Gum Problems
Aqua	X	X
Sorbitol	X	X
Hydrated Silica	X	X
Xylitol	X	X
Glycerin	X	X
Tetrapotassium Pyrophosphate	X	X
Papain	X	X
Titanium Dioxide	X	X
Xanthan Gum	X	X
Potassium Phosphate	X	X
Aroma	X	X
Sodium Fluoride	X	X
Sodium Saccharin	X	X
Diazolidinyl Urea	X	X
Panthenol		X
CI 42090	X	

5.22 ZENDIUM

	Zendium Classic	Zendium Dentine Sensitive	Zendium Fresh Mint	Zendium Cool Mint	Zendium Mild Whitener	Zendium Mild antitannsten med Whitener	Zendium Junior	Zendium Første Tann
Aqua	X	X	X	X	X	X	X	X
Sorbitol	X	X	X	X	X	X	X	X
Hydrated Silica	X	X	X	X	X	X		X
Steareth-30	X	X	X	X	X	X	X	X
Glycerin	X	X	X	X	X	X	X	X
Carrageenan	X	X		X	X		X	X
Aroma	X	X	X	X	X	X	X	X
Titanium Dioxide	X	X	X	X	X	X	X	X
Monosodium Phosphate	X	X	X	X				
Sodium Fluoride	1100 ppm F ⁻	1450 ppm F ⁻	1100 ppm F ⁻	1100 ppm F ⁻	1100 ppm F ⁻	1100 ppm F ⁻	1000 ppm F ⁻	1000 ppm F ⁻
Citric Acid	X	X		X				X
Sodium Benzoate	X	X	X	X	X	X	X	X
Sodium Saccharin	X	X	X	X	X	X	X	X
Potassium Thiocyanate	X	X	X	X	X	X	X	X
Glucose Oxidase	X	X	X	X	X	X	X	X
Amyloglucosidase	X	X	X	X	X	X	X	X
Lactoperoxidase	X	X	X	X	X	X	X	X
Xylitol		X		X			X	
Potassium Nitrate		X						
Xanthan Gum		X						
Disodium Phosphate			X			X	X	X
Sodium Phosphate					X			
Caprylic/Capric Triglycerid					X	X		
Tetrapotassium Pyrophosphate						X		

5.23 ZYMBION

	Zymbion Q 10
Aqua	X
Sorbitol	X
Calcium Carbonate	X
Glycerin	X
Palm Kernel Glycerides	X
Sodium Lauroyl Sarcosinate	X
Ubiquinone (Q10)	X
Sodium Monofluorophosphate	1500 ppm F ⁻
Sucrose Laurate	X
Aroma	X
Cellulose Gum	X
Carbomer	X
Collagen	X
Citric Acid	X
Sodium Benzoate	X
Sodium Saccharin	X
CI 77007	X
CI 77891	X

6. MOUTHWASHES ON THE NORWEGIAN MARKET AND THEIR INGREDIENTS

6.1 COLGATE

	Colgate Total Munnskyll
Aqua	X
Sorbitol	X
Alcohol	X
Glycerin	X
Aroma	X
Disodium Phosphate	X
PVM/MA copolymer	0,25 %
Sodium Fluoride	50 ppm F ⁻
Sodium Hydroxide	X
Sodium Lauryl Sulphate	X
Sodium Methyl Cocyl Taurate	X
Sodium Saccharin	X
Triclosan	0,03 %
CI 42090	X

6.2 CORSODYL

	Corsodyl Mouthwash
Chlorhexidine Gluconate	2 mg
Ethanol (96%)	0.07 ml
Sorbitol	140 mg
Makrogol-glyserolhydroxystearath	X
Peppermint Oil	X
Aqua	X

6.3 DENIVIT

	Denivit Original	Denivit Mint
Aqua	X	X
Alcohol	X	X
Xylitol	X	X
Sorbitol	X	X
PEG 60 Hydrogenated castor oil	X	X

Aroma	X	X
Lauryl Glucoside	X	X
Sodium Fluoride	X	X
Klorhexidine Digluconate	X	X
Sodium Saccharin	X	X
CI 42090		X

6.4 FLUORID

	Fluorid Tannskyllevæske med fluor – med smak	Fluorid Tannskyllevæske med fluor – uten smak
Aqua	X	
Sodium Fluoride	0,5 mg/ml	
Methylparaben	X	
Propylparaben	X	
Aroma	X	

6.5 HEXTRIL

	Hextril
Aqua	X
Alcohol	X
Polysorbate 60	X
Aroma	X
Hexetidine	0,1 %
Citric Acid	X
Sodium Saccharin	X
Methyl Salicylate	X
Menthol	X
Peppermint Oil	X
Clove Oil	X
Anise Oil	X
Eucalyptus Oil	X
CI 14720	X

6.6 LISTERINE

	Listerine Original	Listerine CoolMint
Aqua	X	X
Alcohol	X	X
Thymol	X	X
Eucalyptol	X	X
Methyl Salicylate	X	X
Menthol	X	X
Propanol	X	X
Benzoic acid	X	X
Sodium Benzoate	X	X
Poloxamer 407	X	X
Sorbitol	X	X
Caramel – Acid Proof	X	
Sodium Saccharin		X
Mint		X
FD&C Green No 3		X

6.7 SIKOTOL

	Sikotol
Aqua	X
Alcohol	X
Menthol	X
Phenyl Salicylate	X
Peppermint Oil	X

Sodium Lauryl Sulphate	X
Anethole	X
Eugenol	X
Aroma	X
Lemon Oil	X
Sodium Saccharin	X
CI 17195	X

6.8 SOLIDOX

	Solidox Frisk Pust Munnskyllevann
Aqua	X
Sorbitol	X
Glycerin	X
Alcohol	X
Zinc Acetate	X
Aroma	X
PEG-40 Hydrogenated Castor Oil	X
Sodium Fluoride	X
Potassium Acesulfame	X
Chlorhexidine Diacetate	X
CI 42051	X

6.9 VADEMECUM

	Vademecum Munnvann - Original	Vademecum Munnskyll - Original
Aqua	X	X
Alcohol	X	
Sodium Benzoate	X	
Menthol	X	
PEG-40 Hydrogenated Castor Oil	X	
PEG-60 Hydrogenated Castor Oil		X
Propylene Glycol	X	
Peppermint Oil	X	
Eugenol	X	
Anethole	X	
Geranium	X	
Glycerin		X
Citric acid		X
Potassium Sorbate		X
Sodium C 14-16 Olefin Sulfonate		X
Sodium Hydroxide		X
Aroma		X
Sodium Fluoride		X
Bromochlorophene		X
Sodium Saccharin		X
Sodium Methylparaben		X
CI 42051		X

6.10 ZENDIUM

	Zendium Munnskyllevann	Zendium Dentine Munnskyll
Aqua	X	X
Glycerin	X	X
Xylitol	X	X
Sorbitol	X	X
Steareth-30	X	X
Sodium Benzoate	X	X
Citric Acid	X	X
Sodium Hydroxide	X	X
Allantoin	X	X
Aroma	X	X
Glucose Oxidase	X	X

Amyloglucosidase	X	X
Sodium Fluoride	250 ppm F ⁻	250 ppm F ⁻
Potassium Thiocyanate	X	X
Tricalcium Citrate	X	X
Lactoperoxidase	X	X
Potassium Citrate		X
CI 42051	X	X

7. INGREDIENTS OF TOOTHPASTES AND MOUTHWASHES IN ALFABETICAL ORDER

Acacia: The dried gummy exudate from the trunk and branches of *Acacia senegal* and other species of *Acacia*. It is practically odourless. Insoluble in alcohol. Used as an emulsifying and a suspending agent. It is often used with tragacanth (33).

Albizzia Lebbeck: It is a fast growing plant, very tolerant to dryness, requiring full sun (34). It is claimed that the bark of *Albizzia Lebbeck* has an anti-inflammatory effect, it is shown to have a stabilizing effect on mast cells, reducing the release of histamine (35).

Alcohol (C₂H₅OH): A mixture of ethyl alcohol and water. A clear, colourless, mobile, volatile, readily inflammable liquid with a characteristic spirituous odour and burning taste. Used as a solvent in mouthwashes.

Allantoin (C₄H₆N₄O₃): A white, odourless, tasteless, crystalline powder. It occurs naturally in comfrey root, but is also prepared synthetically. Allantoin is claimed to stimulate tissue formation and hasten wound healing. It appears to have keratin-dispersing activity (36). Allantoin alleviates the skin irritation effects of soap and detergent surfactants, oils and acidic or alkaline material. Allantoin has recently been used in various dental preparations such as toothpastes and mouthwash as an abrasive and astringent agent (37). The FDA OTC Panel has not recognized Allantoin as a wound-healing agent, only as a skin protectant (38).

Aloe Vera: Aloe Vera gel is a mucilaginous preparation obtained from the leaves of *Aloe Vera* (= *A. barbadensis*) (33). Aloe Vera consists of Aloin and Emodin which help reduce mouth inflammation. It also contains saponins possessing antibacterial properties and polysaccharide that is well effective in healing sores in the mouth (39). Aloe Vera has antibacterial, anti-inflammatory and healing properties.

Alumina, aluminium oxide: A compound, occurring naturally as corundum and in hydrated form as bauxite, that is the raw material in aluminum production; impure crystalline forms include emery, ruby, and sapphire. Very fine grains of Alumina are used as abrasives (40).

Aluminium Magnesium Silicate, magnesium aluminium silicate: A mixture of particles with colloidal particle size of montmorillonite and saponite, free from grit and nonswellable ore. Almost white powder, granules, or plates. Swells in water to form a colloidal dispersion. It is used as a suspending and thickening agent and as an emulsion stabiliser.

Aluminium Silicate, polynam, kaolin (Al₂SiO₅): An inorganic chemical that replaces the use of siliceous chemicals viz. precipitated silica, hydrated calcium silicate,

magnesium trisilicate etc. (41). Aluminium Silicate is used as a filler and extender in toothpastes. It is also an anti-caking agent (42).

Amyloglucosidase: An enzyme catalysing the hydrolysis of α -1,4-glucosidic linkages of polysaccharides such as starch, glycogen, or their degradation products. Vegetable or microbial origin. It has the same uses as Glucose Oxidase.

Anethole (C₁₀H₁₂O): A white or faintly yellow crystalline mass, melting at or above 23° C to a colourless or faintly yellow liquid with a sweet taste and the characteristic odour of anise. It is obtained from anise oil or other sources, or prepared synthetically. Very slightly soluble in water, soluble 1 in 2 of alcohol. It is used as flavouring agent (43).

Anhydrous Natural Betaine: Also called Trimethylglycine (TMG) C₅H₁₁NO₂ (33). The natural source for TMG is plants from the Chenopodiaceae family. In its natural form, TMG is a white crystal with a distinctive mildly sweet taste and after taste (44). Betaine has been shown to produce significant relief of dry mouth (45).

Anise Oil, *illicium verum*, *pimpinella anisum*: A colourless or pale yellow oil obtained by distillation from aniseed or star anise. It has a characteristic odour and a sweet aromatic taste. It contains about 80 to 90 % of anethole. Soluble 1 in 3 of alcohol (90 %). Aniseed or anise is carminative and mildly expectorant; it is used mainly as anise oil or as preparations of the oil. The oil is a flavouring agent (36).

Anise Extract, *pimpinella anisum*: An extract from the fruit *Pimpinella anisum*. It is used as a flavouring agent (33).

Aqua, H₂O: A clear, colourless, odourless and tasteless liquid. It is used as a solvent.

Aroma: Fragrance or odor, especially that of a spice or medicine or of articles of food or drink (40).

Aseptine: A derivate of Benzoic acid. Used as a preservative.

Azadirachta indica, neem: *A. indica*, commonly referred to as the neem tree, is a member of the *Meliaceae* family. It is native to parts of South Asia. Used as an astringent and an antiseptic (46).

Baleria prionitis, porcupine flower: Porcupine flower is a flowering, spiny invader. The leaves are used to promote healing of wounds and to relieve toothache. It also has antiseptic properties (47).

Benzoic Acid (C₆H₅.CO₂H): Colourless light feathery crystals or white scales or powder with a slight characteristic odour. Soluble 1 in 300 to 350 of water, 1 in 20 of boiling water, 1 in 3 of alcohol, soluble in glycerol, very soluble in fats and oils. Benzoic acid has antibacterial and antifungal properties. It is a moderately effective preservative for pharmaceutical preparations providing that the pH is not above 5; above this pH it is much less effective since its antimicrobial properties are due to the undissociated acid (36).

Butylparaben, butyl hydroxybenzoate (C₁₁H₁₄O₃): An aromatic ester that occurs as a crystalline powder. Very slightly soluble in water, freely soluble in alcohol. It is used as an antifungal preservative (33).

BHT, butylated hydroxytoluene (C₁₅H₂₄O): Tasteless, colorless crystals or white crystalline powder, odourless or with a faint odour. Practically insoluble in water, soluble 1 in 4 of alcohol. BHT is used as an antioxidant for oils and fats (36).

Bi Propolis, bee glue: Propolis is a resinous substance collected by bees. Propolis has been reported to have anti-inflammatory and antimicrobial properties (33). It is also claimed to be a gum stimulant (48).

Blackthorn, prunus spinosa: A medicinal tincture is prepared from the fresh flower buds of the Blackthorn. The oil is obtainable by crushing the Plum kernel - this is clear, yellow in colour and has an agreeable almond flavour and smell (49). It is a flavouring agent and dye. Blackthorn is also claimed to have anti-inflammatory properties (50).

Bromochlorophene (C₁₃H₈Br₂Cl₂O₂): Bromochlorophene is a halogenated bisphenol antiseptic more active against Gram-positive than Gram-negative bacteria (33). It is used as a preservative.

Burnet Saxifraga, pimpinella saxifraga: It is a herb from the family of *Umbellife*. It resembles caraway, but the fruits are smaller and less aromatic (51). It is employed as an astringent (52).

Calcium Carbonate (CaCO₃): A fine, white, odourless, microcrystalline powder. Practically insoluble in water (33). It is a natural polisher (abrasive) (53), and a plaque acid neutralizer (48).

Calcium Gluconate (C₁₂H₂₂CaO₁₄): A white, odourless, tasteless, crystalline or granular powder containing about 9 % of calcium. Slowly soluble 1 in 30 of water; soluble 1 in 5 of boiling water, practically insoluble in alcohol. Incompatible with oxidising agents, citrates, and soluble carbonates, phosphates and sulphates. Calcium gluconate has the actions of calcium salts. Some of the calcium salts are used as a basis or abrasive in dental preparations (33). It can also be used as an anti-caking agent and as a thickener (54).

Calcium Glycerophosphate (C₃H₇CaO₆P(+xH₂O): A mixture in variable proportions of calcium (RS)-2,3-dihydroxypropyl phosphate and of calcium 2-hydroxy-1-ethyl phosphate, which may be hydrated. A white hygroscopic powder. Sparingly soluble in water; practically insoluble in alcohol (33). It is claimed to prevent cavity formation by reinforcing calcium bioavailability.

Calendula, calendula officinalis, marybud: Calendula, the flowers of *Calendula officinalis*, has antiseptic, anti-inflammatory, and astringent properties. Calendula is included in numerous herbal preparations to improve their appearance (33).

Camphor: Camphor is a ketone obtained from *Cinnamomum camphora* or produced synthetically. Colourless or white crystals, granules, or crystalline masses, or colourless to white, translucent, tough masses with a penetrating characteristic odour (33). Camphor oil is used to a certain extent in antiseptic and disinfectant preparations.

Caprylic Acid Triglyceride (C₂₇H₅₀O₆): Has the same general properties of the medium-chained triglycerides. Practically insoluble in water, miscible with alcohol. It has been used as a basis for the preparation of oral suspensions of drugs unstable in aqueous media (33).

Carbomer: A synthetic high molecular weight polymer of acrylic acid cross-linked with allylsucrose and containing 56 to 68 % of carboxylic acid groups. A white, fluffy, acid, hygroscopic powder with a slight characteristic odour. It is soluble in water, alcohol and glycerol (33). Carbomer is used in toothpastes as a thickener.

Carrageenan, chondrus extract: A dried aqueous extract from species of Chondrus, Gigartina, Eucheuma or other members of the families *Gigartinaceae* and *Solieriaceae*. A white to yellowish coarse or fine, almost odourless powder with a mucilaginous taste. Soluble 1 in 100 of water at 85°C. It disperses more readily if first mixed with alcohol. Carrageenan is an anionic polysaccharide used as an emulsifying, suspending and thickening agent in gels (36).

Catechu, acacia catechu: A dried aqueous extract of the leaves and young shoots of *Uncaria gambier* occurring as dull pale greyish-brown to dark reddish-brown cubes. Odourless or almost odourless. Uses: Catechu is an astringent (33).

Cellulose Gum, carmellose sodium: A white to cream-coloured, odourless or almost odourless, hygroscopic powder or granules with a bland mucilaginous taste. Soluble in water at all temperatures, yielding a clear solution; practically insoluble in alcohol, ether and most other organic solvents. Cellulose Gum is used as a suspending agent, and as an emulsifying agent for oil-in-water emulsions but is less efficient than methyl cellulose. Higher concentrations, such as 4 to 6 %, are used in the preparation of gels which can be employed as bases for applications and pastes; glycerol is usually included in these preparations to prevent drying-out (36).

Chamomile, chamomilla recutita: Chamomile consists of the dried flower heads obtained from *Chamomilla recutita*, containing blue essential oil. It has a characteristic, pleasant and aromatic odour of apple (33). Its main chemical compounds are Azulene, Chamazulene and Bisababol. These substances have anti-bacterial and anti-inflammatory activities. Used as an anti inflammatory agent (33). Chamomile can also prevent halitosis (39).

Chlorhexidine Acetate (C₂₂H₃₀Cl₂N₁₀·2C₂H₄O₂): A white or almost white, odourless or almost odourless microcrystalline powder with a bitter taste. Sparingly soluble in water; soluble in alcohol, slightly soluble in glycerol and propylene glycol (33).

Chlorhexidine Gluconate (C₂₂H₃₀Cl₂N₁₀·2C₆H₁₂O₇): Chlorhexidine Digluconate is an aqueous solution which contains not less than 190 g per litre and not more than 210 g per

litre of chlorhexidine gluconate. An almost colourless or pale-yellow liquid. Miscible with water; soluble in alcohol. A 5% v/v dilution has a pH of 5.5 to 7.0 (33). Chlorhexidine salts are incompatible with soaps and other anionic materials. The activity may be reduced in the presence of suspending agents such as alginates and insoluble compounds of calcium, magnesium, and zinc. Chlorhexidine acetate is incompatible with potassium iodide. Chlorhexidine is a bisbiguanide antiseptic and disinfectant which is bactericidal or bacteriostatic against a wide range of Gram-positive and Gram-negative bacteria. It is more effective against Gram-positive than Gram-negative bacteria, and some species of *Pseudomonas* and *Proteus* have low susceptibility. It is relatively ineffective against mycobacteria. Chlorhexidine inhibits some viruses and is active against some fungi. It is inactive against bacterial spores at room temperature. Chlorhexidine is most active at a neutral or slightly acid pH. Combinations of chlorhexidine with cetrimide or in alcoholic solution are used to enhance the efficacy. Chlorhexidine is added in mouthwashes to prevent mouth infections including candidiasis and to reduce dental plaque accumulation (33).

Cinnamon Extract, cinnamomum zeylanicum: The dried bark of the shoots of coppiced trees of *Cinnamomum zeylanicum*, containing essential oil. It has a characteristic, aromatic odour. Used as a flavouring agent (33).

Citric Acid (C₆H₈O₇): Odourless or almost odourless, colourless crystals or white crystalline powder with a strongly acid taste. Very soluble in water, freely soluble in alcohol. Citric acid ingested frequently or in large quantities may cause erosion of the teeth and have a local irritant action. It is used as a synergist to enhance the effectiveness of antioxidants and is used in the preparation of effervescent mixtures (33).

Clove Oil, eugenia caryophyllus: A clear yellow liquid obtained by steam distillation from clove (33). The primary chemical constitutions include eugenol, caryophyllene and tannins (55). Used as a flavouring agent (33).

Cocamidopropyl Betaine: The substance is a mixture of many individual substances and can not be adequately represented by a single molecular structure. Provides good foaming and foam liquid stabilization with excellent wetting properties. Compatible with anionic, cationic and nonionic surfactants. It is a secondary surfactant used in combination with other stronger surfactants.

Collagen: A fibrous component of mammalian connective tissue making up almost one third of the total body protein (33). It can enhance the body's own natural healing process. Collagen acts as tissue adhesive, it helps prevent bacterial infections. Collagen provides a matrix for cellular colonization and subsequent connective tissue formation (56).

Colloidal Silicon Dioxide, silica colloidalis anhydrica (SiO₂): A light, fine, white, amorphous powder. It has particle sizes of about 15 nm. Practically insoluble in water and in mineral acids except hydrofluoric acid; dissolves in hot solutions of alkali hydroxides (33). It is used as a suspending agent and thickener, as a stabilizer in emulsions, and as an anti-caking agent and desiccant. It is also used as an abrasive.

Colour Index: The colour substances in dentifrices are usually classified by the Colour Index (CI), published by the Society of Dyers and Colourist (see listing next page):

CI 14720: Carmosine / Azourbine.
 CI 16035: Red 40 Aluminium Lake / FD & C Red No 40
 CI 16255: New cocine / Neutral red
 CI 19140: Tartrazine / FD & C Yellow No 5
 CI 42051: Patent Blue
 CI 42090: Brilliant Blue / FD & C No 1
 CI 47005: Quinoline Yellow / FD & C Yellow No 10
 CI 74160: Pigment Blue
 CI 74260: Pigment Green
 CI 75470: Carmine / Carmine Acid
 CI 75810: Chlorophyll
 CI 77007: Ultramarines
 CI 77891: Titanium Dioxide

Diabenzylidene Sorbitol, DBS: It is a small organic molecule that is capable of inducing gelation in a variety of organic solvents and polymers at a low concentration (57). It is used to give a gel consistency.

Diazolidinyl Urea ($C_8H_{14}N_4O_7$): A mild preservative with excellent stabilising qualities (58). Soluble in water, insoluble in most organic solvents. It realises formaldehyde in aqueous/ polar solvents (59). It has been found to be an effective broad spectrum antimicrobial agent (60). It is a newer preservative in cosmetics.

Dicalcium Phosphate, calcium phosphate ($CaHPO_4$): A white, odourless or almost odourless, tasteless, amorphous powder, containing not less than 90% of calcium phosphates. Practically insoluble in water and alcohol; soluble in dilute mineral acids. Manufactured from phosphoric acid (61). It is used as source for calcium (62), and is also an abrasive (63, 64). It has antioxidant and firming properties (61).

Dicalcium Phosphate Dehydrate: It is an abrasive (64), and is also used to prevent plaque formation (65).

Dimethicones ($CH_3.[Si(CH_3)_2.O]_nSi(CH_3)_3$): Clear, colourless or pale yellow, odourless or almost odourless liquids, practically immiscible with water and alcohol. The Dimethicones are the most important type of silicones. They are stable to heat and resistant to most chemicals. Dimethicones are water-repellent and have low surface tension. They give a barrier on the tooth surface that prevent plaque and staining of the teeth.

Disodium Phosphate ($Na_2HPO_4.xH_2O$): Colourless, odourless, efflorescent, transparent crystals with a salty slightly alkaline taste. Soluble in water, practically insoluble in alcohol. It is used in prevention of dental caries (36). It is also added to toothpaste as a buffering agent (66).

Echinacea: Echinacea is dried roots of *Echinacea augustifolia*. *E. pallida* or *E. purpurea* is sometimes substituted. Echinacea is reported to have immunostimulant properties and is used in herbal preparations for the prophylaxis of bacterial and viral infections (33).

Emblica officinalis, emblic, indian gooseberry: It is one of the oldest Indian fruits. It is a rich source of vitamin C and has a high content of ascorbic acid. Used as a preservative (67).

Esculin ($C_{15}H_{16}O_9 \cdot 1\frac{1}{2}H_2O$): Esculin is present in the bark, leaves, and seeds of the horsechestnut, *Aesculus hippocastanum*. It occurs as a white to slightly cream coloured, odourless, crystalline powder with bitter taste. Very slightly soluble in water, soluble 1 in 6 of boiling water and in 1 in 60 of alcohol. It has capillary-strengthening, antiflogistic and antibacterial properties. This substance has anti-inflammatory properties, it tones up the venous system and increases the resistance of the capillary veins. But the effect is doubtful (36).

Ethanol, dehydrated alcohol: A clear, colourless, mobile, volatile, very hygroscopic, readily inflammable liquid with a characteristic spirituous odour and a burning taste. Used as a solvent in mouthwashes (36).

Ethylparaben, ethyl hydroxybenzoate ($C_9H_{10}O_3$): Colourless crystals or a white or almost white crystalline powder. Odourless or almost odourless. Very slightly soluble in water; freely soluble in alcohol. Used as a preservative (33). The hydrobenzoates are active against moulds, fungi and yeast, but less active against bacteria (36).

Eucalyptol ($C_{10}H_{18}O$): A colourless liquid with an aromatic camphoraceous odour and a pungent cooling taste, obtained from eucalyptus oil, cajuput oil, and other oils. Practically insoluble in water, soluble 1 in 2 of alcohol. Uses: Eucalyptol has the action and uses of eucalyptus oil but is less irritating to mucous membranes. It is a flavouring agent and is claimed to have antimicrobial properties (36).

Eucalyptus Oil: A colourless or pale yellow oil with a characteristic aromatic camphoraceous odour and a pungent camphoraceous cooling taste, obtained by rectifying the oil distilled from the fresh leaves and terminal branches of various species of Eucalyptus which yields oils containing a large proportion of eucalyptol. Very slightly soluble in water, soluble 1 in 5 of alcohol. Used as a flavouring agent (36).

Eugenol ($C_{10}H_{12}O_2$): A colourless or pale yellow liquid with a strongly aromatic odour of clove and a spicy pungent taste; it may be derived from clove oil and cinnamon leaf. Practically insoluble in water; soluble 1 in 2 of alcohol and aqueous sodium hydroxide. It is applied in medical- and dental products due to its analgesic, anaesthetic, antiseptic, and anti-inflammatory effects (68). Eugenol is employed as a flavouring agent in dentifrices, as a curative for hypersensitive dentine, caries or exposed pulp (36).

FD & C Blue no 1, CI 42090 ($C_{37}H_{34}N_2Na_2O_9S_3$): Blue powder or granules. Soluble 1 in 5 of water, alcohol (75 %), and glycerol. Used as a colouring agent (33).

FD & C Green no 3, CI 42053 ($C_{37}H_{34}N_2Na_2O_{10}S_3$): Used as a colouring agent.

FD & C Yellow no 5, CI 19140 ($C_{16}H_9N_4Na_3O_9S_2$): Used as a colouring agent (33).

Fennel Oil: A colourless or pale yellow oil with a characteristic aromatic odour and a bitter camphoraceous taste, obtained by distillation from fennel. Fennel consists of the dry , cremocarps and mericarps of *Foeniculum vulgare*. It contains anethole and about 20 % of fenchone. Soluble 1 in 1 of alcohol. Fennel oil is an aromatic agent (36).

Gall: Excrescences on the twigs of *Quercus infectoria* (Fagaceae), resulting from the stimulus given to the tissues of the young twigs by the development of the larvae of the gall-wasp. It is used for its astringent properties.

Geranium Oil: A colourless, greenish, or brownish oil with a pleasant rose-like odour, obtained by distillation from aerial parts of various species and hybrid forms of Pelargonium. Soluble 1 in 3 of alcohol. Geranium oil is used as perfume (36).

Ginger: The dried, whole or cut rhizome of *Zingiber officinale*, with the cork removed, either completely or from the wide flat surfaces only. Whole or cut, it contains not less than 1.5 % of essential oil. It has a characteristic aromatic odour. It is used as a flavouring agent (33).

Glucose Oxidase: Glucose oxidase is an enzyme obtained from certain fungi which catalyses the oxidation of glucose to gluconic acid, with the concomitant production of hydrogen peroxide. Used as a preservative and for its supposed benefits in the prophylaxis of dental caries (33). It is also claimed to reduce gingivitis and plaque, but these effects are of doubtful value. It is on the other hand proven that glucose oxidase has a positive inhibiting effect on Recurrent Aphthous Ulcers (RAU).

Glycerine (C₃H₈O₃): A clear, colourless, hygroscopic, syrupy liquid, odourless or with a slight odour and with a sweet taste followed by a sensation of warmth. Miscible with water and alcohol. Incompatible with oxidising agents. Glycerine is employed as a sweetening agent and as a humectant (62).

Guar Gum: A gum obtained from the ground endosperms of the seeds of *Cyamopsis tetragonolobus*. It consists chiefly of a high-molecular-weight hydrocolloidal polysaccharides. A white to yellowish-white, practically odourless powder. Dispersible in water forming a colloidal solution. Guar gum is used as a thickening agent and a suspending agent (33).

Hexetidine (C₂₁H₄₅N₃): A viscid oil with faint amine-like odour. Soluble 1 in 10 000 of water. Miscible with alcohol. Hexetidine is inactivated by soaps and alkalis. It has antibacterial and antiprotozoal actions and is effective against *Candida albicans*. It is used as a 0.1% solution to prevent plaque accumulation (36).

Horse-chestnut Extract, aesculus hippocastanum: The seeds of the horse-chestnut, *Aesculus hippocastanum* containing aescin (escin) and other saponins (saponosides). This substance has anti-inflammatory properties, it tones up the venous system and increases the resistance of the capillary veins. But the effect is doubtful (33).

Hydrated Silica, silicon dioxide, colloidal hydrated silica (SiO₂.xH₂O): A light, fine, white or almost white, amorphous powder. Practically insoluble in water, and in

mineral acids except hydrofluoric acid; dissolves in hot solutions of alkali hydroxides. Dental-type silica is an amorphous silica (precipitated, gel, or obtained by flame hydrolysis. It is obtained from sodium silicate solution by destabilising with acid in such a way as to yield very fine particles with a diameter ranging from 0.5 to 40 µm. Silicon Dioxide is used as a suspending and thickening agent. Abrasive (33).

Hydroxyethyl Cellulose: A white, yellowish-white, or greyish-white, powder or granules. Soluble in cold or hot water, forming colloidal solutions; practically insoluble in alcohol. A 1 % colloidal solution in water has a pH of 5.5 to 8.5. It is used in pharmaceutical manufacturing as a thickener, stabiliser and binding agent (36).

Isoceteth 20: It is an emollient ester of cetearyl alcohol composed mostly of cetyl alcohol. It has good emulsifying properties (69, 60). It is also a solubilizer (70).

Jjoba Oil, simmondsia chinensis, buxus chinensis: An oil derived from the seeds of the desert plant *Simmondsia Chinensis*. It has natural preservative, antibacterial and antifungal properties (71).

Juglans regia, english walnut: A medium-sized tree cultivated commercially for the nuts in sub-tropical countries. The bark and leaves have astringent and detergent properties. They have been claimed to cure Herpes, eczema etc, and to heal indolent ulcers.

Krameria Extract, krameria triandra, rhatany root: The dried root of *Krameria triandra*, containing less than 10 % tannins. Rhatany root has astringent properties similar to those of tannic acid. The tincture has been used as an astringent wash for the mucous membrane (36).

Lactoperoxidase: Lactoperoxidase is a glycoprotein with a single hemin prosthetic group. Lactoperoxidase and its cofactors form the lactoperoxidase system (LPS). This system is a natural preservative, having antibacterial activity (72). It is used as a preservative.

Lauryl Glucoside: A mild surfactant made by combining glucose with fatty alcohols from coconut and palm kernel oils.

Lemon Oil, oleum limonis: The oil is obtained from the fresh peel of lemon (*Citrus limonum*). A clear mobile pale yellow to greenish-yellow liquid with a characteristic odour. Used principally as a flavouring agent (33).

Liquorice, ammonium glycyrrhizinate: Liquorice Root consists of the dried unpeeled or peeled, whole or cut root and stolons of *Glycyrrhiza glabra*. Liquorice is used as a flavouring and sweetening agent. It also has ulcer-healing and mild anti-inflammatory properties (33).

Lords and Ladies, arum maculatum: A stemless herb with tuberous roots and large, heart-shaped leaves often with various dark spots. All parts are poisonous (73). Used in homeopathy to heal mouth inflammation (74).

Macrogol Glyceryl Hydroxystearate, lauryl glucosidase ($C_{18}H_{36}O_3$): Used as an emulsifying agent.

Magnesium Aluminium Silicate: It is an odourless or almost odourless, tasteless creamy-white powder or small flakes. Practically insoluble in water. It is used as a suspending, binding and thickening agent and as an emulsion stabilizer (36).

Menthol ($C_{10}H_{20}O$): It occurs as colourless crystals or crystalline powder with a penetrating odour resembling that of peppermint and a warm aromatic taste followed by a local sensation of cold. Very slightly soluble in water, soluble 1 in 0,2 of alcohol. Incompatible with oxidising agents. Used as a flavouring agent (36).

Methylparaben, methyl hydroxybenzoate ($C_8H_8O_3$): Colourless crystals or a fine, white crystalline powder. Odourless or with a faint odour, it is tasteless but produces a slight burning sensation of the mouth and tongue, followed by local numbness. Soluble 1 in 400 to 500 of water, 1 in 20 of boiling water, 1 in 3 to 3.5 of alcohol. Incompatible with alkalis and iron salts. Used as an antimicrobial preservative (36).

Methyl Salicylate, methyl 2-hydroxybenzoate ($C_8H_8O_3$): Methyl salicylate is produced synthetically or is obtained from the leaves of *Gaultheria procumbens* or from the bark of *Betula lenta*. A colourless or pale yellow liquid with a strong persistent characteristic aromatic odour of wintergreen, and sweet warm aromatic taste. Very slightly soluble in water, soluble 1 in 10 of alcohol (70 %), miscible with alcohol (90 %). Incompatible with alkalis and iron salts. Methyl salicylate has the action of salicylates. It is typically used as a flavouring agent (33).

MICA $AB_{2-3}(X, Si)_4O_{10}(O, F, OH)_2$: MICA is a soft, shiny phyllosilicate mineral that splits into very thin sheets. It is added to toothpastes as an abrasive (75,76).

Mimusops elengi: It is a flower from India, which is used for making herbal oils (77). Used as a fragrant oil, but is also claimed to cure gum inflammation (78).

Mint Oil: The essential oil obtained by steam distillation from the fresh flowering aerial parts, recently gathered from *Mentha canadensis* followed by partial separation of menthol by crystallisation. A colourless or pale yellow to greenish-yellow liquid with a characteristic odour. It is used as a flavouring agent (33). Mint gives a fresh feeling and fresh breath. Mint consists of 24-48 % menthol which is bacteriostatic and helps in preventing bad breath (39).

Mono Sodium Phosphate ($NaH_2PO_4 \cdot xH_2O$): It contains one or two molecules of water of hydration, or is anhydrous. Colourless crystals or white crystalline powder. Is odourless and is slightly deliquescent. Freely soluble in water; practically insoluble in alcohol. Its solutions are acid to litmus and effervesce with sodium carbonate. pH of a 5% solution in water of the monohydrate form in between 4.1 and 4.5 (33).

Myrrh Extract, commiphora myrrha: An oleo-gum-resin obtained from the stem of *Commiphora molmol* and possibly other species of Commiphora. Reddish-brown or reddish-yellow tears, with an aromatic odour and a bitter acid taste. Soluble in water to the extent of about 50 % and partly soluble in alcohol. Myrrh is astringent to mucous membranes; the

tincture is used in mouth-washes and for ulcers in the mouth and pharynx (Ma 33) and has an antibacterial effect (79). It is a stimulant to the mucous tissue, and is used for ulcerated aphtous stomatitis (80). Further, myrrh has a pleasant aroma which can help control bad breath odours (62).

Myrtillus: The ripe fruit of *Vaccinium myrtillus*. Myrtillus has astringent properties (33).

Octoxyglycerin: A preservative that is effective against Gram-positive bacteria (81).

Olea europaea, olive tree: A single or multistemmed tree or large shrub. Olive leaf is claimed to have a natural antibacterial, antifungal and antiviral activity (82).

Palm Kernel Glycerides/oil: A yellow oil extracted from the pulp of the fruit of the African palm, *Elaeis guineensis*. It is high in saturated fat (78 %) (83). It is an excellent oil for detergent manufacturing due to its high content of C12 (84).

Panthenol (C₉H₁₉NO₄): When topically applied, panthenol penetrates the mucosa and is converted into pantothenic acid, a B vitamin complex. That is why it is called Provitamin B 5. A white to creamy white, crystalline powder with a slight, characteristic odour. Freely soluble in water, in alcohol, and in propylene glycol. It is an anti-inflammatory agent. It stimulates cellular proliferation and aids in tissue repair (85).

Papain: A proteolytic enzyme or mixture of enzymes prepared from the juice of the unripe fruit of *Carica papaya*. An amorphous or slightly granular, white to light brown powder with a characteristic odour and faint pepsin-like taste. Partly soluble in water, practically insoluble in alcohol. Papain consists chiefly of a mixture of papain and chymopapain, proteolytic enzymes which hydrolyse polypeptides, amines, and esters, especially bonds involving basic amino acids, or leucine or glucine, yielding peptides of lower molecular weight. Used in toothpastes as a non-abrasive whitening agent (30).

Para Cress, spilanthes oleracea, toothache plant: A plant which has no particular odour, but when eaten it has an interesting flavour that slowly develops from pleasant and salty to a strong, thickling-burning pungency that leaves back a numb feeling in the mouth (86). This plant has been given the name toothache plant because if chewed on it can help deaden dental pain (87). Used as a antifungal, antiviral and antiseptic agent and stimulates wound healing (88). It also has a topical anaesthetic effect on gums and teeth (87).

PEG, polyethylene glycols: Polyethylene glycols, also called macrogols in the European pharmaceutical industry, are manufactured by polymerization of ethylene oxide (EO) with either water, monoethylene glycol or diethylene glycol. As an abbreviation for polyethylene glycols, the term “PEG” is used, in combination with a numerical value. Within the pharmaceutical industry, the number indicates the mean molecular weight, whereas in the cosmetic industry the number refers to the number (n) of EO-units in the molecule. Soluble in water (89). Used as solvents and emulsifiers. In toothpastes and mouthwashes you will find: PEG-6, PEG-12, PEG-32, PEG-40, PEG-42, PEG-60, PEG-150

Pentasodium Triphosphate, sodium tripolyphosphate (Na₅P₃O₁₀): White granulous powder, easily soluble in water, no odour (90).

Peppermint Oil, *oleum menthae piperitae*: It is obtained by steam distillation from the fresh over ground parts of the flowering plant *Mentha piperita*. It yields not less than 5 % of esters calculated as menthyl acetate and not less than 50 % of total menthol, free and as esters. It is a colourless or pale yellow liquid with a strong, penetrating, characteristic odour and taste followed by a sensation of cold. Miscible with alcohol. It is used as a flavouring agent in dental preparations (33).

Phenoxyethanol ($C_8H_{10}O$): A colourless, slightly viscous liquid. Slightly soluble in water, mixable with alcohol and glycerol. It is effective against strains of *Pseudomonas aeruginosa* but less against other Gram-negative and Gram-positive bacteria. Used as a preservative at a concentration of 0.5 to 1 %. It is often used in combination with other preservatives, commonly hydroxybenzoates, to obtain a wider spectrum of antibacterial activity (33).

Phenyl Salicylate, hydroxybenzoic acid phenyl ester, salol ($C_{13}H_{10}O_3$): Salol is a salicylic acid derivate (33).

Piper Longum, indian long pepper: It is a slender, aromatic, climber with perennial woody roots, creeping and jointed stems, and fleshy fruits embedded in the spikes. Its principle constituents are piperine and piperlongumine (91). It is claimed to have antibacterial activity (92).

Poloxamer 407: Poloxamers is a series of non ionic polyoxyethylene-polyoxypropylene copolymers with the general formula $HO(C_2H_4O)_a(C_3H_6O)_b(C_2H_4O)_aH$. Poloxamer 407 is a poloxamer in which a in the general formula averages 101 and b averages 56. It is a white or almost white, waxy powder, microbeds, or flakes. Odourless or with a very mild odour. Freely soluble in water and alcohol. Poloxamers are used as emulsifying agents (33).

Polysorbate 60 ($C_{64}H_{126}O_{26}$): A mixture of partial stearic esters of sorbitol and its mono- and di- anhydrides. An opaque lemon-coloured or yellowish-brown semi-gel. It has a faint characteristic odour and a slightly bitter taste. Miscible with water and alcohol. Non-ionic polysorbates are oil-in-water emulsifying agents (33).

Potassium Acesulfame ($C_4H_4KNO_4S$): A white, crystalline powder or colourless crystals. Soluble in water, very slightly soluble in alcohol. It is a high-intensity, non-caloric sweetener. It is approximately 200 times sweeter than sucrose (33).

Potassium Chloride (KCl): Odourless, colourless, cubical, elongated, or prismatic crystals or white crystalline powder with a saline taste. Freely soluble in water, practically insoluble in alcohol (33). It is an electrolyte replenisher (93). It is used as a source for potassium (94). Potassium chloride acts by blocking the open dentine tubules and is therefore used to decrease hypersensitivity (95,1)

Potassium Citrate ($C_6H_5K_3O_7$): Transparent, odourless, hygroscopic crystals or a white granular powder with a fresh saline taste. Soluble 1 in 1 of water, practically insoluble in alcohol. Incompatible with calcium and strontium salts. Potassium citrate is used to prevent dentine hypersensitivity (36).

Potassium Nitrate (KNO_3): Odourless, colourless crystals or white crystalline powder with a cooling saline taste. Soluble 1 in 3.3 of cold water, 1 in 0.5 of boiling water, 1 in 620 of alcohol. It has the ability to prevent dentine hypersensitivity (36).

Potassium Sorbate ($\text{C}_6\text{H}_7\text{KO}_2$): White or creamy-white crystals or powder with a faint characteristic odour. Soluble 1 in less than 1 of water and 1 in 70 of alcohol. Potassium sorbate has the actions and uses of sorbic acid, but is more soluble in water. Sorbic acid has antibacterial and antifungal properties. It is active against moulds and yeasts and to a lesser degree against bacteria. It is not effective above about pH 6.5; the optimum pH is about 4.5. Its fungistatic activity is increased by the addition of acids and sodium fluoride. It is used as a preservative in pharmaceutical and cosmetic preparations (36).

Potassium Tartrate ($\text{C}_4\text{H}_4\text{K}_2\text{O}_6 \cdot \frac{1}{2}\text{H}_2\text{O}$): Colourless transparent crystals, odourless, it tastes saline and cooling, deliquescent. It is composed of potassium and tartaric acid. Soluble in water, almost insoluble in alcohol (96). It is an antioxidant (97). And is also used as a stabilizer and thickening agent (98).

Potassium Thiocyanate (KSCN): Colourless, odourless deliquescent crystals with a saline taste. Soluble 1 in 0.5 of water and 1 in 10 of water. It is a fungicide (36). Potassium thiocyanate together with glukoseoxidase and lactoperoxidase, produces the hypothiocyanate ion. This ion inhibits the growth and acid production of plaque forming bacteria. It is therefore used as an anticariogenic enzyme (99).

Propylene Glycol ($\text{CH}_3\text{CHOH}\cdot\text{CH}_2\text{OH}$): A clear, colourless, odourless or almost odourless, viscous hygroscopic liquid with a slightly sweet taste, resembling that of glycerol. Miscible with water and alcohol. It is used as a solvent and in the preparation of solutions which are insufficiently soluble in water or unstable in aqueous solutions. It is used similarly to glycerol in non-greasy applications to prevent drying out (33).

Propylparaben, propyl hydroxybenzoate ($\text{C}_{10}\text{H}_{12}\text{O}_3$): Colourless crystals or white crystalline powder, odourless or with a faintly aromatic odour. It is tasteless but it numbs the tongue. Very slightly soluble in water, freely soluble in alcohol. Incompatible with alkalis and iron salts. Used as an antifungal preservative (33).

PVM/MA Copolymer ($\text{C}_7\text{H}_8\text{O}_4$)_n:

The non-proprietary designation for a polyvinyl methyl ether/ maleic acid copolymer. A copolymer is a polymer containing monomers of more than one kind. A white powder, soluble in hot water. PVM/MA is used as a suspending agent and gelling agent for aqueous and aqueous-alcoholic solutions for external use. PVM/MA is used in toothpaste combined with triclosan. It enhances the uptake of triclosan in enamel and epithelium cells. It also gives a greater retention of triclosan in oral plaque and saliva (100). Some studies show that PVM/MA combined with triclosan, pyrophosphate or zinc citrate can inhibit the formation of supragingival calculus to some extent (16).

Polyvinylpyrrolidone, PVP ($\text{C}_6\text{H}_9\text{NO}$)_n: A fine white or very slightly cream-coloured, odourless or almost odourless, tasteless powder. Soluble in water and alcohol. PVP

is used in pharmacy as a suspending and dispersing agent. It is also used as a binding agent, emulsion stabilizer, and non-surfactant (33).

Q-10, Ubiquinone-10 (C₅₉H₉₀O₄): A yellow to yellowish-orange, odourless, tasteless, crystalline powder. Practically insoluble in water, very slightly soluble in alcohol. Ubiquinone is a naturally occurring coenzyme involved in electron transport in the mitochondria. It is claimed to be a free radical scavenger and to have antioxidant membrane stabilizing properties (33).

Red Sandalwood, pterocarpus santalinus: An oil derived from a small evergreen tree, *Genus Santalum*, of tropical Asia. Red Sandalwood is solely used for coloring and dyeing (101).

Rosemary Oil: The essential oil obtained by steam distillation from the flowering aerial parts of *Rosmarinus officinalis*. A clear, mobile, colourless to pale yellow liquid with a characteristic odour. It is used as perfume and a flavouring agent (33).

Sage, salvia officinalis: The dried leaves of the red or garden sage, *Salvia officinalis*, containing 1 to 2.5 % of volatile oil. Used as red flavouring agent.

Salvadora persica, tooth-brush tree: A short evergreen tree suitable for arid regions and sandy soils. *S. persica* decoction possesses significant anti-inflammatory activity (102).

Sanicle, sanicula europaea: A plant that produces round fruit covered in barbed thorns. It has a slightly, bitter taste. It has mild astringent properties (50).

Sident® 9: Sident is precipitated silica. It is an abrasive with average abrasion property.

Sident® 22 S: Used as a thickener in toothpastes. Defines flow characteristics and storage stability via paste viscosity.

Silica (SiO₂): A fine, white, odourless, hygroscopic, amorphous powder in which the diameter of the average particles ranges from 2 to 10 µm. Practically insoluble in water and alcohol. A 5 % suspension in water has a pH of 4 to 8. It is occurring in nature as agate, sand, amethyst, chalcedony, cristobalite, flint, quartz, and tridymite (40). It is used pharmaceutically as a suspending, disintegrating, and anti-caking agent. In granular form it is used as a desiccant, a dental abrasive and a polishing agent. It is also used as a thickener (40).

Sorbic Acid, acidum sorbicum (C₆H₈O₂): A white or creamy white crystalline powder with a faint characteristic odour and a slightly acid and astringent taste. Soluble 1 in 700 of water, 1 in 10 of alcohol, 1 in 7 of dehydrated alcohol. Sorbic acid has antibacterial and antifungal properties. It is active against moulds and yeasts and to a lesser degree against bacteria. It is not effective above about pH 6.5. The optimum pH is about 4.5. Its fungistatic activity is increased by the addition of acids and sodium chloride. It is used as a preservative in the pharmaceutical and cosmetic preparations at a usual concentration of up to 0.1 to 0.2 % (36).

Sodium Alginate, algin: It consists chiefly of the sodium salt of alginic acid, and is obtained chiefly from algae belonging to the Phaeophyceae, mainly species of Laminaria. A white or buff powder which is odourless or almost odourless and tasteless. Slowly soluble in water, forming an off-white to yellowish-brown viscous colloidal solution; practically insoluble in alcohol. Sodium alginate has little surface activity and its emulsifying power is chiefly achieved by increasing the viscosity of the aqueous phase. It is used chiefly as a suspending and thickening agent and in the preparation of water-miscible pastes, creams and gels. According to the viscosity required, from 1 to 10 % is used in the preparation of pastes and creams (36).

Sodium Benzoate ($C_6H_5.CO_2Na$): A white, slightly hygroscopic, crystalline or granular powder or flakes. Odourless or with a faint odour of benzoin, and an unpleasant, sweetish, saline taste (36). Freely soluble in water, sparingly soluble in alcohol. Incompatible with quaternary compounds, ferric salts, calcium salts, and salts of heavy metals. Their activity is also diminished by non-ionic surfactants or due to absorption by kaolin. Benzoates have antibacterial and antifungal properties. Their antimicrobial activity is due to the undissociated benzoic acid and is therefore pH dependent. They are relatively inactive above a pH of about 5. Benzoates are used as preservatives (33).

Sodium Bicarbonate, baking soda ($NaHCO_3$): A white odourless crystalline powder with a saline slightly alkaline taste. Soluble 1 in 11 of water, practically insoluble in alcohol. Incompatible with acids and acidic salts. Sodium Bicarbonate has anti-caries and abrasive properties (36). It is also used as a thickening agent (103).

Sodium C14 – 16 Olefin Sulfonate: It is a sodium salt, and a mild surfactant.

Sodium Carrageenan: Derived from seaweed (63). Used as a thickener (48).

Sodium Chloride, sea salt ($NaCl$): A white crystalline powder or colourless crystals or white pearls. Freely soluble in water; practically insoluble in dehydrated alcohol (33). It increases saliva flow (104).

Sodium Citrate ($C_6H_5Na_3O_7$): White odourless granular crystals or crystalline powder with saline taste. Soluble 1 in less than 2 of water; practically insoluble in alcohol. Added to reduce sensitivity (105). It is also claimed to reduce staining, but not proven to be significant (106). When sodium citrate is complexed by heavy metal ion such as zinc, it has the ability to inhibit the initiation of the inflammatory process by preventing the polymorphonuclear leucocytes from producing the chemotactic factors associated with inflammation (107).

Sodium Fluoride (NaF): A white odourless powder. Sodium fluoride 2.2 mg is approximately equivalent to 1 mg fluoride. Soluble 1 in 25 of water, practically insoluble in alcohol. Incompatible with calcium and magnesium salts. Sodium fluoride is used for the prophylaxis of dental caries. It renders the dentine and enamel of the teeth more resistant to acid (36).

Sodium Hydroxide ($NaOH$): White, crystalline masses supplied as pellets, sticks, or slabs. It is deliquescent and readily absorbs carbon dioxide. Very soluble in water, freely soluble in alcohol. It is strongly alkaline and corrosive, and rapidly destroys organic tissues

(33). Sodium hydroxide acts as a base to neutralize the low pH conditions produced by plaque bacteria and to enable their easy removal.

Sodium Lauryl Sarcosinate: It is a mild-cleansing agent derived from coconut oil. Mild detergent and mild foaming agent (66). Some manufacturers claim that it can also reduce staining, but tests show only a slight improvement, not significant (106).

Sodium Lauryl Sulphate: A mixture of sodium alkyl sulphates, consisting mainly of sodium dodecyl sulphate, $C_{12}H_{25}NaO_4S$. It is a white or pale yellow powder or crystals with a slight characteristic odour. Freely soluble in water; partly soluble in alcohol (33). It is an anionic amphiphile, which exhibits high affinity for proteins and is a strong denaturing agent. Incompatible with cationic materials and with acids below pH 2.5. Sodium lauryl sulphate may be irritant to the skin and mucosa. It may also damage the mucosal mucin layer by denaturing its glycoproteins. The epithelium will then be more exposed for irritants and this can result in aphtous ulcerations in some patients. Sodium lauryl sulphate is an anionic emulsifying agent. It is a detergent and wetting agent, effective in both acid and alkaline solution and in hard water (33). It also has antimicrobial activity due to its ability to interfere with membranes and a variety of biologic processes in micro-organisms (108).

Sodium Methyl Cocoyl Taurate: It is a surfactant.

Sodium Monofluorophosphate (Na_2PO_3F): A white to slightly grey, odourless powder. Freely soluble in water (33). Each g provides 6.9 mmol of fluoride (36). Sodium Monofluorophosphate is used as a source of flouride in toothpastes, and is reported to cause less staining than stannous fluoride (36).

Sodium Phosphate (NaH_3PO_4): A white powder or colourless crystals. Very soluble in water; very slightly soluble in alcohol (33). It is used as an emulsifier.

Sodium Saccharin ($C_7H_4NNaO_3S.2H_2O$): White efflorescent crystals or a white, odourless or faintly aromatic, crystalline powder with an intensely sweet taste. Soluble 1 in 1.5 of water and 1 in 50 of alcohol. Sodium saccharin is added to toothpastes and mouthwashes as a sweetening agent. In dilute solution it is about 300 times as sweet as sucrose (36).

Sodium Silicate, soluble glass, water glass ($Na_2O.NSiO_2$): It is an inorganic chemical made by combining various ratios of silica and sodium carbonate at high temperature (109). Sodium Silicate is used to obtain dental type silica.

Sorbitol ($C_6H_{14}O_6$): A white, slightly hygroscopic, odourless, microcrystalline powder, granules, or flakes with a sweet taste. Sorbitol is about one-half as sweet as sucrose. Soluble 1 in 0.5 of water and 1 in 25 of alcohol. Incompatible with oxidising agents (36). In addition to providing sweetness, it is an excellent humectant and texturising agent (110).

Spearmint Oil, oleum mentha viridis/crispae: A colourless, pale yellow or greenish-yellow oil with the characteristic odour of spearmint and a warm and slightly bitter taste. It is obtained by distillation from fresh flowering spearmint, *Mentha viridis* or Scotch

Spearmint, *Mentha cardiaca*. Soluble 1 in 1 of alcohol (80 %). Spearmint oil has similar properties to peppermint oil. It is used as a flavouring agent (36).

Stannous Pyrophosphate ($\text{Sn}_2\text{P}_2\text{O}_7$): It is added to dental preparations as a source of pyrophosphate, which is an anti-calculus agent.

Stearate-30: Stearate is any salt (soap), ester, or anionic form of stearic acid. Stearate-30 is a surfactant and emulsifier.

Sterculia Urens, indian tragacanth, karaya gum: Sterculia is the gum obtained from *Sterculia urens*. Irregular or vermiform pieces, greyish-white with a brown or pink tinge. Sparingly soluble in water; practically insoluble in alcohol. Sterculia is used as an emulsifier and stabiliser (33).

Sucrose Laurate: It is a sugar ester (111) with the ability to inhibit the growth of *Bacillus* and *Alicyclobacillus* spores (112). It is used as a preservative (112).

Symplocos racemosa, lodh tree: *S. racemosa* is a small tree, with dark green leathery leaves. Antimicrobial actions of some fractions obtained from the bark of *S. racemosa* have been investigated (113).

Tartaric Acid ($\text{C}_4\text{H}_6\text{O}_6$): A white or almost white, crystalline powder or colourless crystals. Very soluble in water, freely soluble in alcohol. Used in the preparation of effervescent material (33).

Tea Tree Oil, melaleuca alternifolia, melaleuca oil: A clear, mobile, colourless to pale yellow liquid with a characteristic odour (33). It is an essential oil obtained by distillation from the leaves of the Australian Tea Tree, *Melaleuca alternifolia*. Soluble 1 in 3 of alcohol (36). Tea Tree Oil has been reported to have bactericidal and fungicidal properties (33). *Melaleuca alternifolia* is used as a flavouring agent.

Terminalia belerica, bahera tree: A large deciduous tree. The fruits are ovoid green and contain a green fixed oil, saponin, tannins, a resinous residue and three amorphous and hygroscopic glycosidal compounds. It has antiseptic and astringent properties (114).

Terminalia chebula, myrobalans fruits, hirda fruits: It is a tree with a rounded crown and spreading branches. Its principle constituents contain chebulinic acid and corilagin. The fruit can be used as an astringent (78).

Tetrapotassium Pyrophosphate, TSPP: It is produced by molecular dehydration of dibasic sodium phosphate. Insoluble in alcohol. It is added to dental preparations as a source of pyrophosphate, which is an anti-calculus agent.

Thymol ($\text{C}_{10}\text{H}_{14}\text{O}$): Colourless crystals or white crystalline powder with a characteristic pungent aromatic odour and taste. Very slightly soluble in water; very soluble in alcohol. It is incompatible with iodine, alkalis, and oxidising agent. Thymol is a phenolic agent with antibacterial and antifungal properties. Its antimicrobial activity is diminished through

combination with protein (33). A powerful disinfectant, but its use is limited by its low solubility in water. It is an irritant to tissues. Thymol is used chiefly as a deodorant in mouthwashes and gargles.

Titanium Dioxide, Colour Index 77891 (TiO₂): A white or almost white powder. Practically insoluble in water. Gives white colour in toothpaste

Tocopheryl Acetate (C₃₁H₅₂O₃): A clear, odourless or almost odourless, slightly greenish-yellow, viscous oily liquid. Practically insoluble in water, freely soluble in dehydrated alcohol. Tocopherol is natural vitamin E that occurs in vegetable oil. It is a genuine antioxidant (60).

Tormentil: Tormentil consists of the whole or cut, dried rhizome, freed from the roots, of *Potentilla erecta*. It has astringent properties (33).

Tragacanth: The dried gummy exudation from *Astragalus gummifer* or other Asiatic species of *Astragalus*. It occurs as odourless, flattened, lamellated, frequently curved fragments or straight or spirally twisted linear pieces. It is used as a suspending and emulsifying agent (33).

Tricalcium Citrate, calcium citrate: A white, odourless, crystalline powder. Slightly soluble in water; insoluble in alcohol. Tricalcium citrate is the calcium salt of citric acid (115). It is used as a firming agent, as an acidity regulator and as a sequestrant (115).

Triclosan (C₁₂H₇Cl₃O₂): A white to off-white crystalline powder or soft agglomerates with a slightly aromatic odour. Practically insoluble in water. It is a non-ionic chlorinated phenolic agent. Contact dermatitis has occasionally been reported. Other reported adverse effects are dry oral mucosa, taste disturbances in concentrations above 0,3 % , desquamation of oral epithelium, hairy tongue and erythema. It is used for its antibacterial and anti-plaque effect (33).

Trisodium Phosphate (Na₃PO₄): A chemical that is available in crystal form that acts as a disinfectant when rehydrated in water (115). It has disinfecting properties (115).

Vitamin B5/pantothenic acid (C₉H₁₇NO₅): An unstable, extremely, hygroscopic, viscous oil. Freely soluble in water. Pantothenic acid is an essential vitamin required for the biosynthesis of co-enzyme A in mammalian cells. Panthenol (pro-vitamin B5) has the same effect as pantothenic acid. Panthenol has accelerating effect on wound healing in damaged epithelium in oral mucosa (30).

Vitamin E, alpha tocopherol: Vitamin E is a generic term applied to a large number of natural or synthetic compounds. The most important substances are the tocopherols of which alpha tocopherol are the most active. It is a fat-soluble vitamin. Vitamin E prevents the oxidation of polyunsaturated fatty acids. It reacts with free radicals, which are the cause of oxidative damage to cell membranes, without the formation of another free radical in the process (33).

Wheatgerm Oil, *triticum vulgare*: This oil is made from the germ of the wheat. Although the germ only constitutes 3 % of the weight of a wheat grain, it contains nearly 25 % of the protein, vitamins and minerals. Wheatgerm oil is very high in vitamin E and essential fatty acids (7). It is used for its high content of vitamin E which has antioxidant properties.

Xanthan Gum: A gum produced by a pure-culture fermentation of a carbohydrate with *Xanthomonas campestris*. It is a cream-coloured powder. Soluble in hot and cold water. Xanthan gum is used as a stabiliser, thickener, and emulsifier (33).

Xylitol ($C_5H_{12}O_5$): A polyhydric alcohol related to the pentose sugar, xylose. A white, odourless, hygroscopic, crystalline powder with a sweet taste. Soluble in water and alcohol. Xylitol can not be fermentated by oral micro organisms. It is used as sweetening agent that may also have anti-caries properties since it can reduce or even prevent a pH drop (116).

Zinc (Zn): A white metal with a bluish tinge. The half-life in saliva is about 45 minutes. The effect of zinc is better in mouthwashes than in toothpastes (117). It is used as an antibacterial, anti-plaque, anti-calculus and anti-halitosis agent.

Zinc Acetate ($(CH_3.CO_2)Zn.2H_2O$): Colourless or white crystals or granules with a faint acetous odour and a sharp disagreeable astringent metallic taste. It effloresces slowly to form a basic salt. Soluble 1 in 2.5 of water, 4 in 1 of boiling water, 1 in 30 of alcohol and 1 in 3 of boiling alcohol. A 5% solution in water has a pH of 6-8. Incompatible with solutions of soluble carbonate, phosphates, tannic acid and sulphurated potash. It is used as a source of zinc (36).

Zinc Citrate ($Zn_3(C_6H_5O_7)2.2H_2O$): It is used as a source for zinc. It is also used as a copolymer with Triclosan.

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